In This Section

- River Basin Description
- Population and Land Use
- Local Governments and Planning Authorities
- Water Use Classifications

Section 2

River Basin Characteristics

This section describes the following major characteristics of the Savannah River basin:

- *River basin description* (Section 2.1): the physical features and natural processes of the basin.
- *Population and land use* (Section 2.2): the sociological features of the basin, including the types of human activities that might affect water quality and water resource use.
- *Local governments and planning authorities* (Section 2.3): identification and roles of the local authorities within the basin.
- *Water use classifications* (Section 2.4): description of water use classification and baseline goals for management of waters within the basin as defined in the state regulatory framework.

2.1 River Basin Description

This section describes the important geographical, geological, hydrological, and biological characteristics of the Savannah River basin.

The physical characteristics of the Savannah River basin include its location, physiography, soils, climate, surface water and ground water resources, and natural water quality. These physical characteristics influence the basin's biological habitats and the ways people use the basin's land and water resources.

2.1.1 River Basin Boundaries

The Savannah River basin is located in eastern Georgia where its headwaters originate in the Blue Ridge Province of Georgia, and North and South Carolinas (Figure 2-1). The basin parallels the Georgia and South Carolina border passing through the Piedmont Province and upper and lower Coastal Plains before reaching the Atlantic

Figure 2-I. Location of the Savannah River Basin

Ocean. The Savannah River defines the state boundary between Georgia and South Carolina and the river basin is shared with North and South Carolina. The Savannah River basin has an area of 10,577 square miles in which 175 square miles are in southwestern North Carolina, 4,581 square miles are in western South Carolina, and 5,821 square miles are in eastern Georgia.

The U.S. Geological Survey (USGS) has divided the Savannah River basin into seven subbasins or Hydrologic Unit Codes (HUCs; see Table 2-1), within Georgia. These HUCs are referred to repeatedly in this report to distinguish conditions in different parts of the basin. Figure 2-2 shows the location of these subbasins and the associated counties within each subbasin.

Table 2-I. Hydrologic Unit Codes (HUCs) of the Savannah River Basin in Georgia

03060102	Tugaloo River
03060103	Upper Savannah River
03060104	Broad River
03060105	Little River
03060106	Middle Savannah River
03060108	Brier Creek
03060109	Lower Savannah River

2.I.2 Climate

The Savannah River basin is characterized by mild winters and hot summers in the lower portions, and cold winters and mild summers in the mountain area. Mean annual precipitation ranges from 40 to 80 inches per year. Precipitation occurs chiefly as rainfall, and to a lesser extent, as snowfall. Rainfall is fairly evenly distributed throughout the year, but a distinct dry season occurs from mid-summer to late fall. Rainfall is usually greatest in March and least in October. The mean annual temperature is about 65 degrees Fahrenheit.

2.I.3 Physiography, Geology, and Soils

Physiography

The Savannah River basin contains parts of the Blue Ridge, Piedmont and Coastal Plain physiographic provinces, which extend throughout the southeastern United States. Similar to much of the Southeast, the basin's physiography reflects a geologic history of mountain building in the Appalachian Mountains and long periods of repeated land submergence in the Coastal Plain Province. The northernmost part of the Savannah River basin is within the Blue Ridge Province where the headwaters arise. Less than one percent of the basin lies within the Blue Ridge Province. The Blue Ridge Province is dominated by rugged mountains and ridges that range in altitude from 3,000 to 3,500 feet (ft). Runoff is quite rapid because of the steep terrain and steep stream gradients in this province. The boundary between the Blue Ridge and the Piedmont is defined by a sharp change in slope at an altitude of approximately 1,700 ft.

The Blue Ridge and Piedmont provinces are underlain by mostly Precambrian as well as early Paleozoic crystalline rocks that include a wide variety of schists, gneisses, amphibolites, phyllites and granites. Less extensive outcrops of quartzites are also present. The area is characterized by numerous inactive fault zones and joint patterns

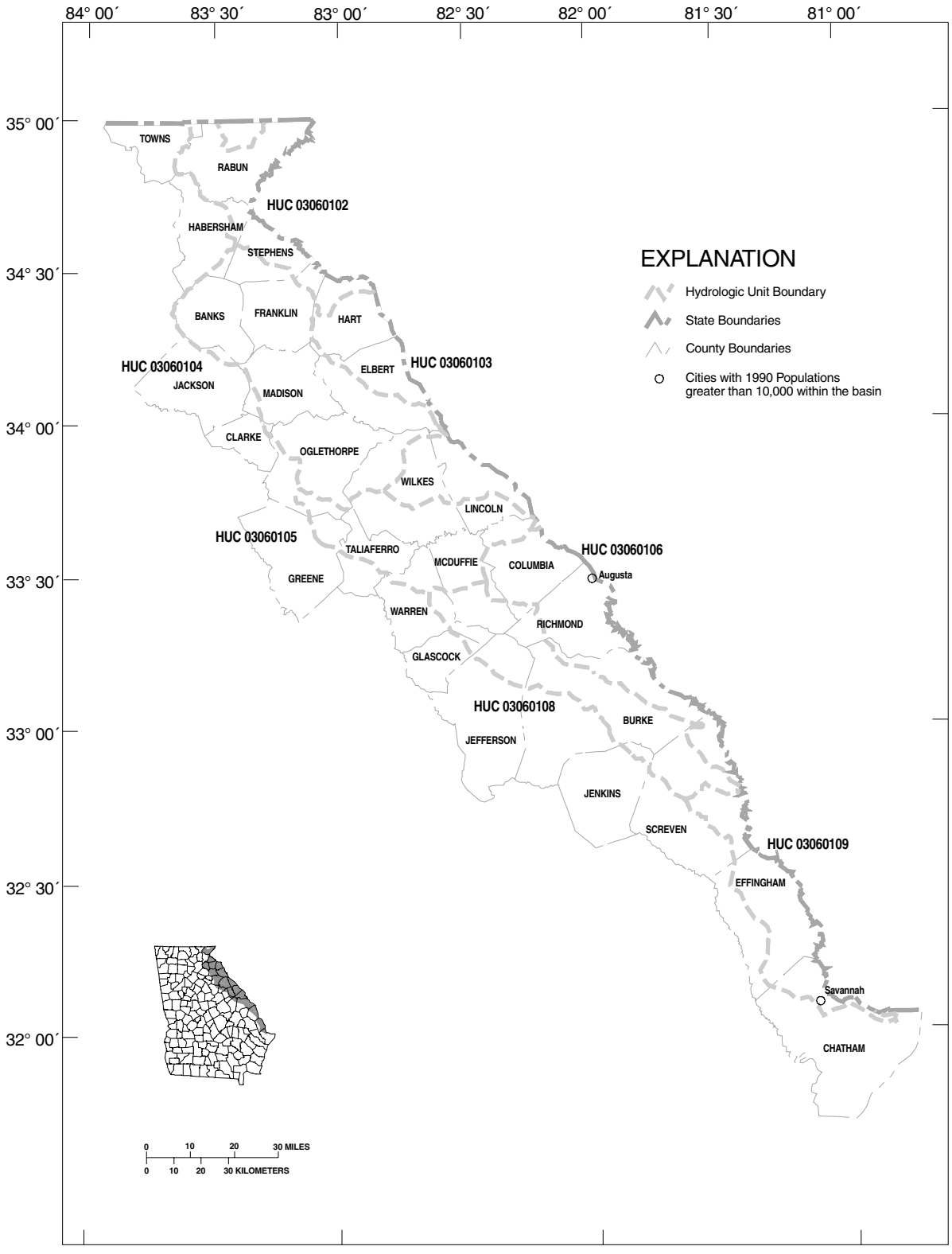

Figure 2-2. Hydrologic Units and Counties of the Savannah River Basin

within the rocks that dictate the surface stream patterns and ground water resources. The crystalline rocks typically are overlain by a porous, residual soil generally known as saprolite.

The Fall Line is the boundary between the Piedmont and Coastal Plain provinces. This boundary approximately follows the contact between older crystalline metamorphic rocks of the Piedmont Province and the younger unconsolidated Cretaceous and Tertiary sediments of the Coastal Plain Province. As implied by the name, streams flowing across the Fall Line can undergo abrupt changes in gradient, which are marked by the presence of rapids and shoals. Geomorphic characteristics of streams differ between the Piedmont and Coastal Plain provinces. In the Coastal Plain, streams typically lack the riffles and shoals common to streams in the Piedmont and exhibit greater floodplain development and increased sinuosity.

Geology

The Savannah River basin is located within three physiographic provinces: the Blue Ridge, Piedmont and the Coastal Plain provinces. The Blue Ridge and Piedmont provinces, which constitute approximately 60 percent of the Savannah River basin, are underlain by crystalline metamorphic and igneous rocks. The metamorphic rocks originally were sedimentary, volcanic, and igneous plutonic rocks that have been altered by several stages of regional metamorphism as well as several episodes of granite intrusion. The majority of the exposed rocks of the Savannah River basin consist of several types of gneiss, largely made up of biotite gneiss, granite gneiss, and amphibolite. Granites are locally important in the basin as are metasedimentary rocks such as metagraywackes, quartzites, and schists. Less than 0.1 percent of the Savannah River basin is occupied by ultramafic rock units.

Coastal Plain sediments are constitute approximately 40 percent of the Savannah River basin. Approximately 80 percent of the sediments are sands and clays. The rest include calcareous sediments and Quaternary alluvium. The Coastal Plain sediments overlap the southern edge of the Piedmont Province at the Fall Line and those sediments nearest to the Fall Line are Cretaceous to Eocene in age. They are dominantly terrestrial to shallow marine in origin and consist of sand, kaolinitic sand, kaolin, and pebbly sand. These sediments host the major kaolin deposits in Georgia with many of these deposits found within the Savannah River basin.

Much of the southeastern Piedmont is covered by deeply weathered bedrock called saprolite. Average saprolite thickness in the Piedmont rarely exceeds 20 meters, but the thickness can vary widely within a short distance. A considerable amount of ground water flows through the saprolite and recharges streams in the Piedmont. Saprolite is easily eroded when covering vegetation and soil are removed. Extensive erosion of soil and saprolite caused by agricultural practices during the 1800s and early 1900s contributed a vast quantity of sediment into stream valleys, choking the streams and raising the streams base level. As conservation practices stabilized erosion, streams began to reestablish grade and cut into the thick accumulations of sediments, remobilizing them into the major rivers and eventually into reservoirs.

Soils

The Savannah River watershed in Georgia crosses 5 Major Land Resource Areas (MLRA's) (Figure 2-3). Soils vary widely across the watershed, ranging from nearly level to very steep, from shallow to very deep, from excessively drained to very poorly drained, and from sandy to clayey. There are some general trends with soils across the watershed. Going from north to south, degree of slope decreases, water tables are generally higher, and soil textures go from loamy in the Blue Ridge, to clayey in the

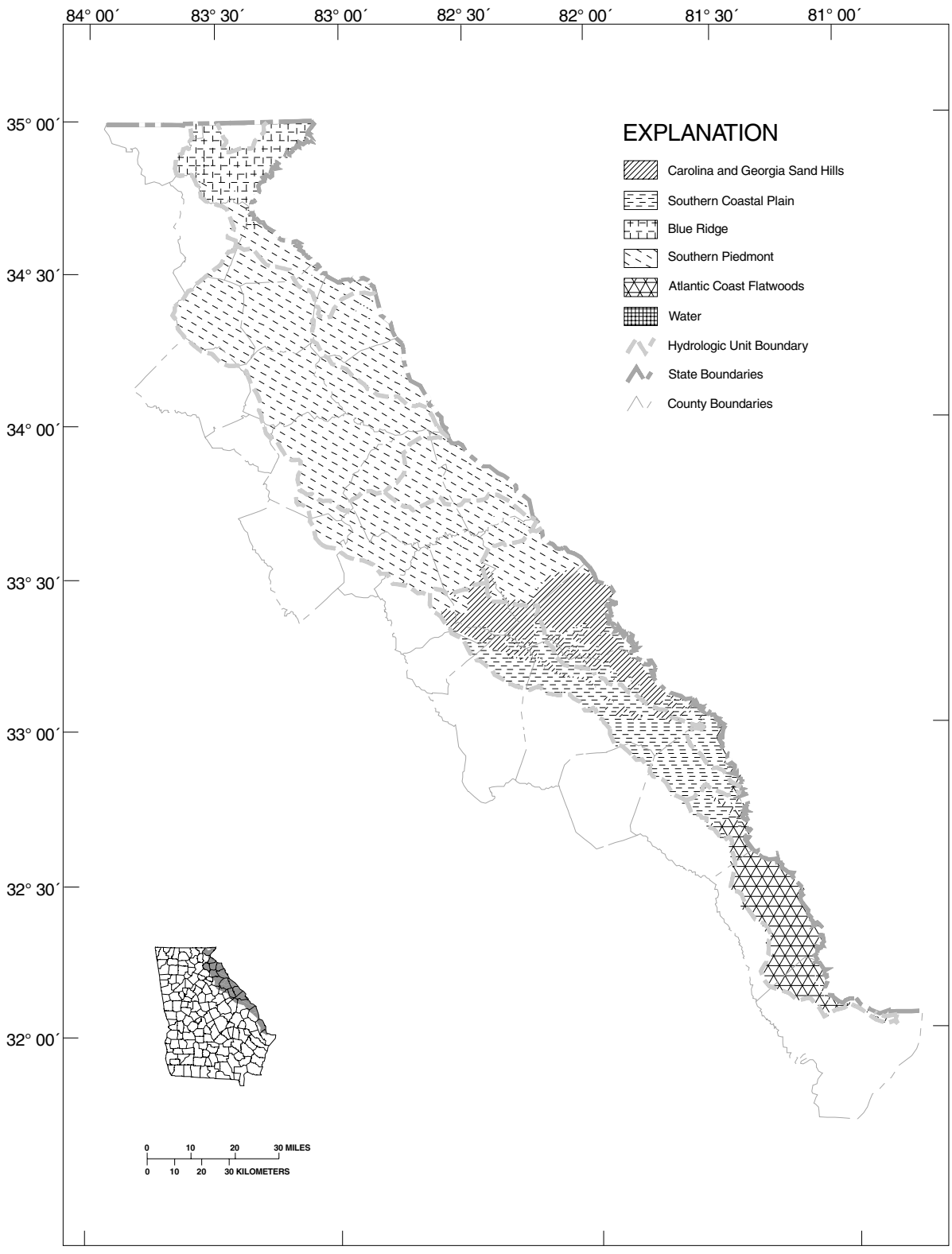

Figure 2-3. Major Land Resource Areas in the Savannah River Basin

Southern Piedmont, to sandy or sandy over loamy in the Sand Hills, Coastal Plain, and Atlantic Coast Flatwoods.

About 6 percent of the watershed is in the Blue Ridge MLRA. Most of the soils in this area formed from weathered granite, gneiss, and schist. These are the steepest soils in the watershed, with slopes in most areas ranging from 25 to 60 percent. Soils on the steeper slopes and higher elevations are commonly loamy throughout, are brown to yellowish red, and are shallow or moderately deep to bedrock. Deep to very deep, red clayey soils are common in less sloping areas at lower elevations.

About 60 percent of the watershed is in the Southern Piedmont MLRA. Most of the soils in this region are very deep, well drained, red clayey soils that formed from felsic, high grade metamorphic or igneous rocks. There is a significant area in the central part of this region that contains soils formed from intermediate and mafic crystalline rocks. These soils have slower permeability and are less acid than typical Piedmont soils. Also significant is an area in the lower portion of the Piedmont that has soils formed from Carolina slate. These soils are still clayey, but have a higher silt content than typical Piedmont soils.

About 8 percent of the watershed is in the Carolina and Georgia Sand Hills MLRA. Soils in this area formed primarily in sandy and loamy marine sediments, which occasionally overlie residual Piedmont materials. There are two major groups of soils in this area. One group consists of deep sands ranging from 40 to more than 80 inches deep. The other group consists primarily of soils that have a sandy surface and a loamy subsoil, often exhibiting dense or brittle properties. Soils in this MLRA are generally less developed than soils in other parts of the watershed.

About 17 percent of the watershed is in the Southern Coastal Plain MLRA. Soils in this part of the watershed are more variable than in other parts, particularly with regards to textures and water table depths. Typically, soils have a sandy surface layer that orderlies a red to yellow, loamy subsoil. The depth of the sandy surface is quite variable. Soils in this region are on more gently sloping landforms than in previously mentioned MLRA's. There is a continuum of soils ranging from well drained soils on ridges and hillsides to poorly drained soils in depressions and along drainageways.

About 9 percent of the watershed is in the Atlantic Coast Flatwoods MLRA. Landforms in this part of the watershed are nearly level. Water tables are generally closer to the surface in this area than in other parts of the watershed. Typically, soils have a sandy surface layer that is 20 to 40 inches deep over a loamy subsoil. This varies considerably, however. Characteristic of part of this MLRA are sandy soils that have an accumulation of an organic matter-aluminum complex.

2.1.4 Surface Water Resources

The Chattooga and Tallulah Rivers join in the Savannah River headwaters to form the Tugaloo River. Further downstream near Hartwell, Georgia, the Tugaloo River joins with the Seneca River from South Carolina to form the Savannah River. From here the Savannah River flows southeasterly to the Atlantic Ocean. Other significant basin features within Georgia are the three major tributaries, Broad and Little Rivers, and Brier Creek that flow into the Savannah River and are located entirely within Georgia. Also located along the Tallulah, Tugaloo, and Savannah Rivers are several hydroelectric facilities and their associated impoundments. Finally, at the terminus of the river is the Savannah River harbor.

The Savannah River, which is approximately 300 miles long, is the most extensively used surface water resource in the basin. It is fed by many moderate-sized tributaries, some of which have drainage areas greater than 200 square miles and are significant

surface water resources in their own right. The major impoundments in the basin are Hartwell Lake, Richard B. Russell Lake, and Clarks Hill Lake, all Corps of Engineers reservoirs. Hartwell Lake is a 56,000 acre reservoir located at the confluence of Tugaloo River and Seneca River. Richard B. Russell Lake is a 26,000 acre reservoir just downstream from Hartwell Lake. Clarks Hill Lake is a 70,000 acre reservoir on the Savannah River northwest of Augusta.

The topography varies from elevation 5,500 feet at the headwaters of the Tallulah River, to about 1,000 feet in the rolling and hilly piedmont province, descending to around 200 feet at Augusta, Georgia, and from the gently rolling to the nearly flat coastal plain province from Augusta to the Atlantic Ocean.

Runoff averages about 15 inches annually over the entire drainage area. Runoff at Augusta, Georgia, averages about 19 inches.

Following are descriptions of each of the bodies of water mentioned. Stream networks within each of the HUCs are shown in Figures 2-4 through 2-10.

Chattooga River

The Chattooga River originates on the crest of the Blue Ridge in the mountains of North Carolina. It flows southward through the mountains for 10 miles in North Carolina, and then continues for 40 miles as the boundary between Georgia and South Carolina before ending in Lake Tugaloo. This is one of the longest and largest free-flowing mountain streams in the Southeast. The Tallulah River originates in southwestern North Carolina and flows south into Georgia. Along the river are several Georgia Power hydroelectric facilities including Burton, Mathis, Nacoochee, Rabun, Tallulah Falls, and Terrora . Like the Chattooga River, the Tallulah River flows into Lake Tugaloo, another Georgia Power hydroelectric facility reservoir. The Tugaloo River begins below the confluence of the Chattooga and Tallulah Rivers. The Tugaloo River flows into Lake Hartwell where it joins with the Seneca River from South Carolina to form the Savannah River.

Upper Savannah River

The upper Savannah River is dominated by two U.S. Army Corps of Engineers reservoirs, Lake Hartwell Reservoir and Clarks Hill Lake. These reservoirs are used for hydroelectric power generation, flood control, recreation, flow regulation, and fish and wildlife. The Broad River flows into the headwaters of Clarks Hill Lake, while the Little River flows into the downstream reach of the reservoir and becomes an arm of the reservoir.

Broad River

The headwaters of the Broad River, the North and Middle Forks, begin in the Chattahoochee National Forest in Banks, Habersham, and Stephens counties. The river flows generally southeast before terminating in Clarks Hill Lake. The Broad River basin is approximately 1500 square miles and is located primarily in the Piedmont Province.

Little River

The Little River basin is an approximately 765 square mile watershed located midway in the basin. The Little River flows east to slightly northeast to the Savannah River. It joins the Savannah River in Clarks Hill Lake. The backwater from the lake extends far up into the Little River creating an arm of the lake.

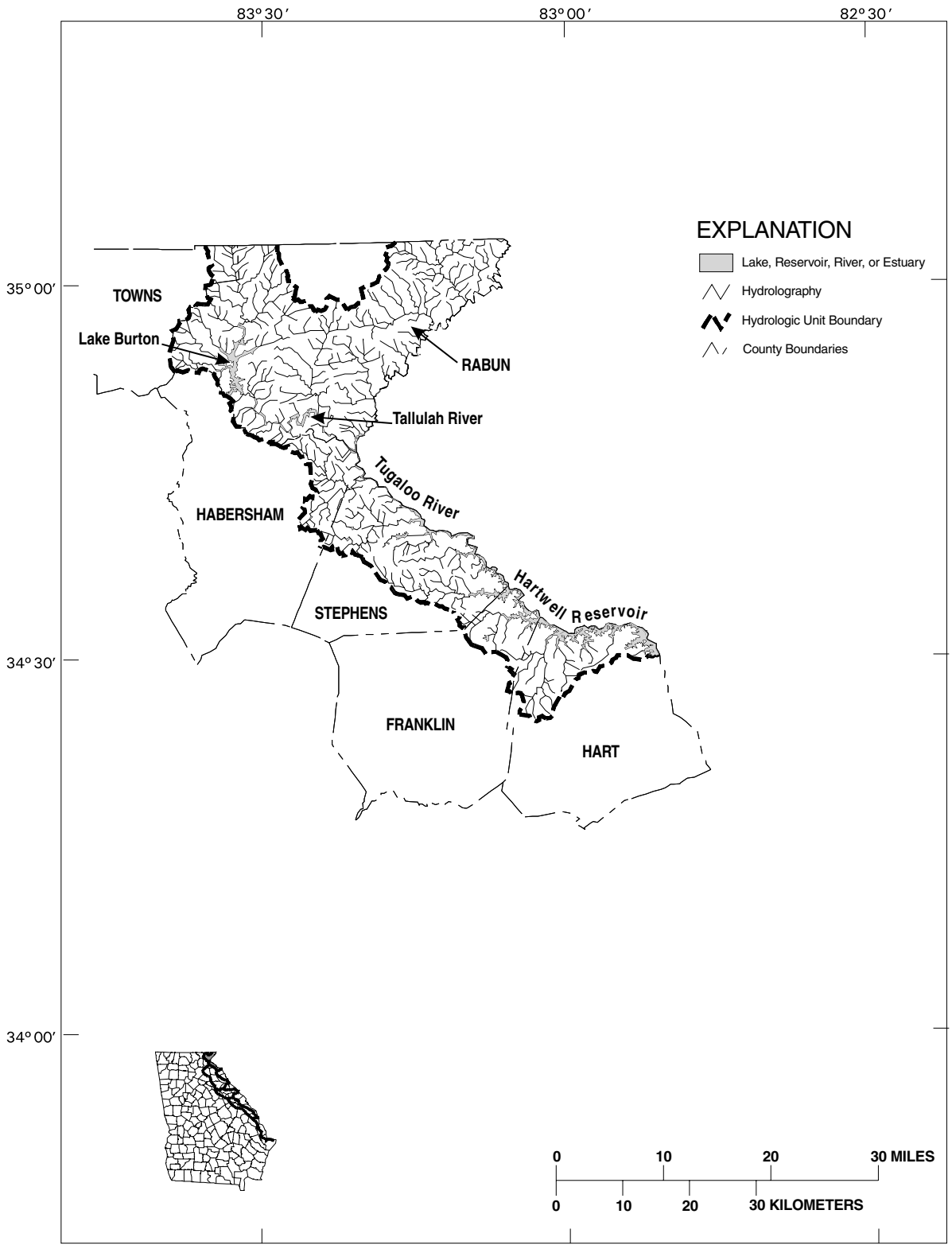

Figure 2-4. Hydrography, Savannah River Basin, HUC 03060102

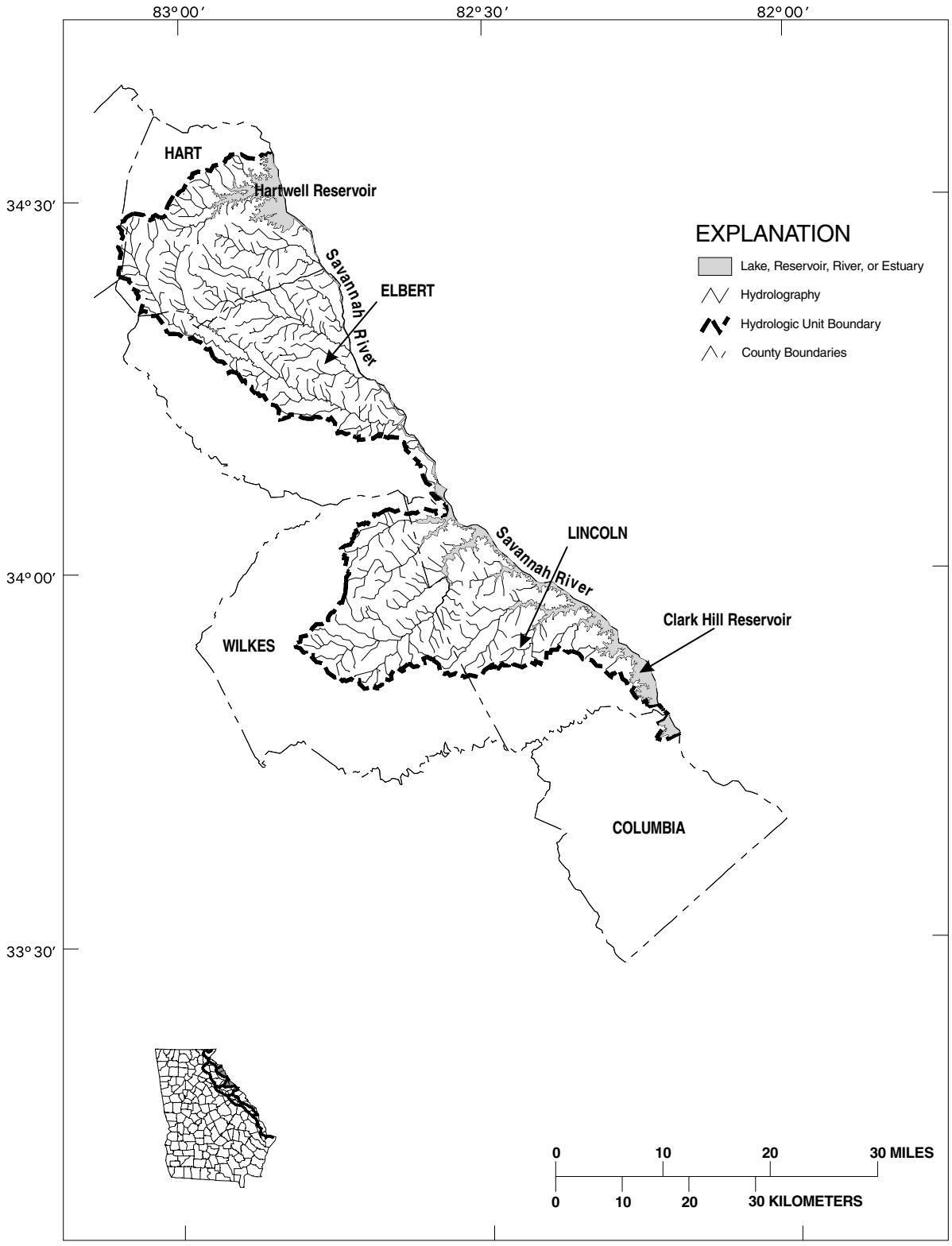

Figure 2-5. Hydrography, Savannah River Basin, HUC 03060103

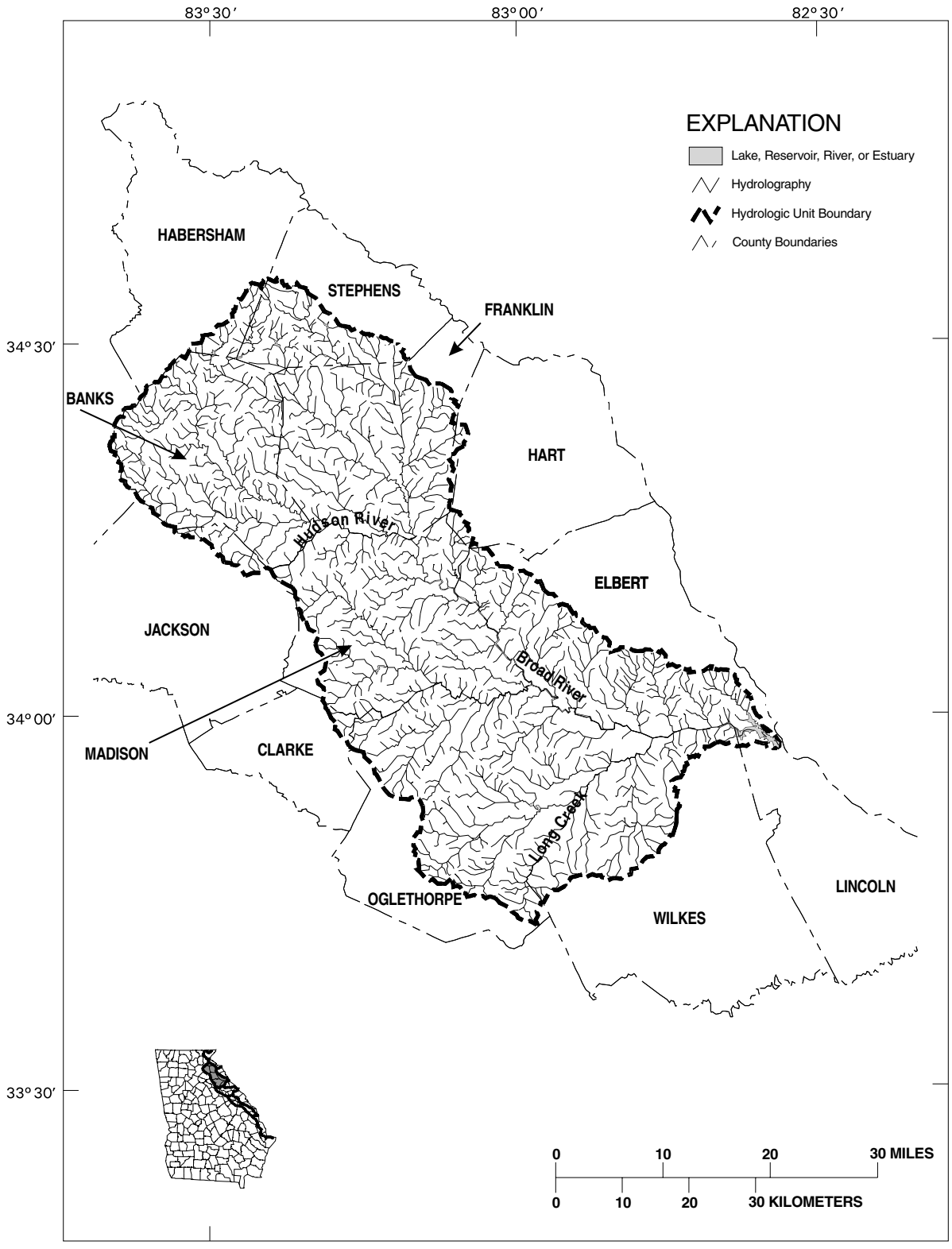

Figure 2-6. Hydrography, Savannah River Basin, HUC 03060104

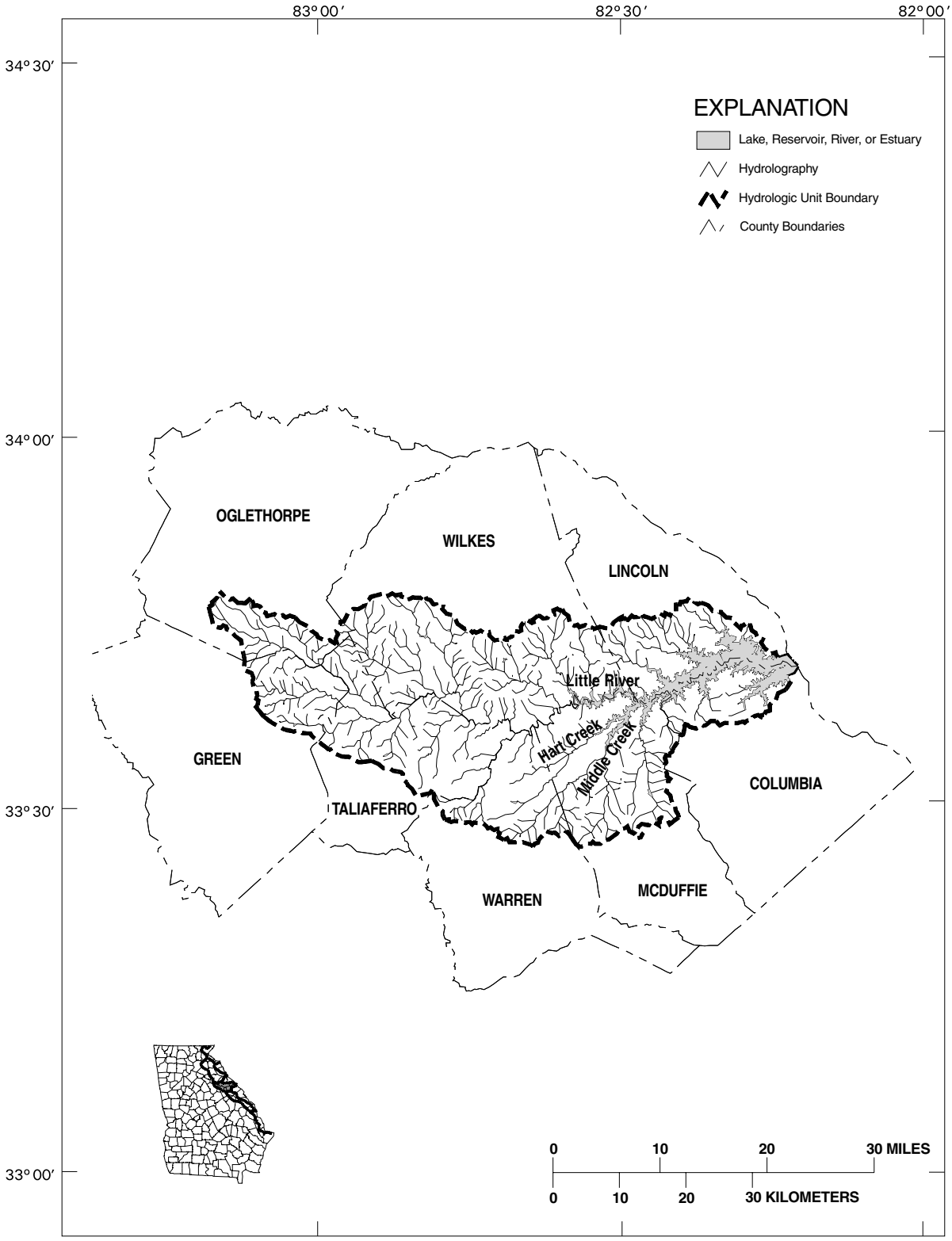

Figure 2-7. Hydrography, Savannah River Basin, HUC 03060105

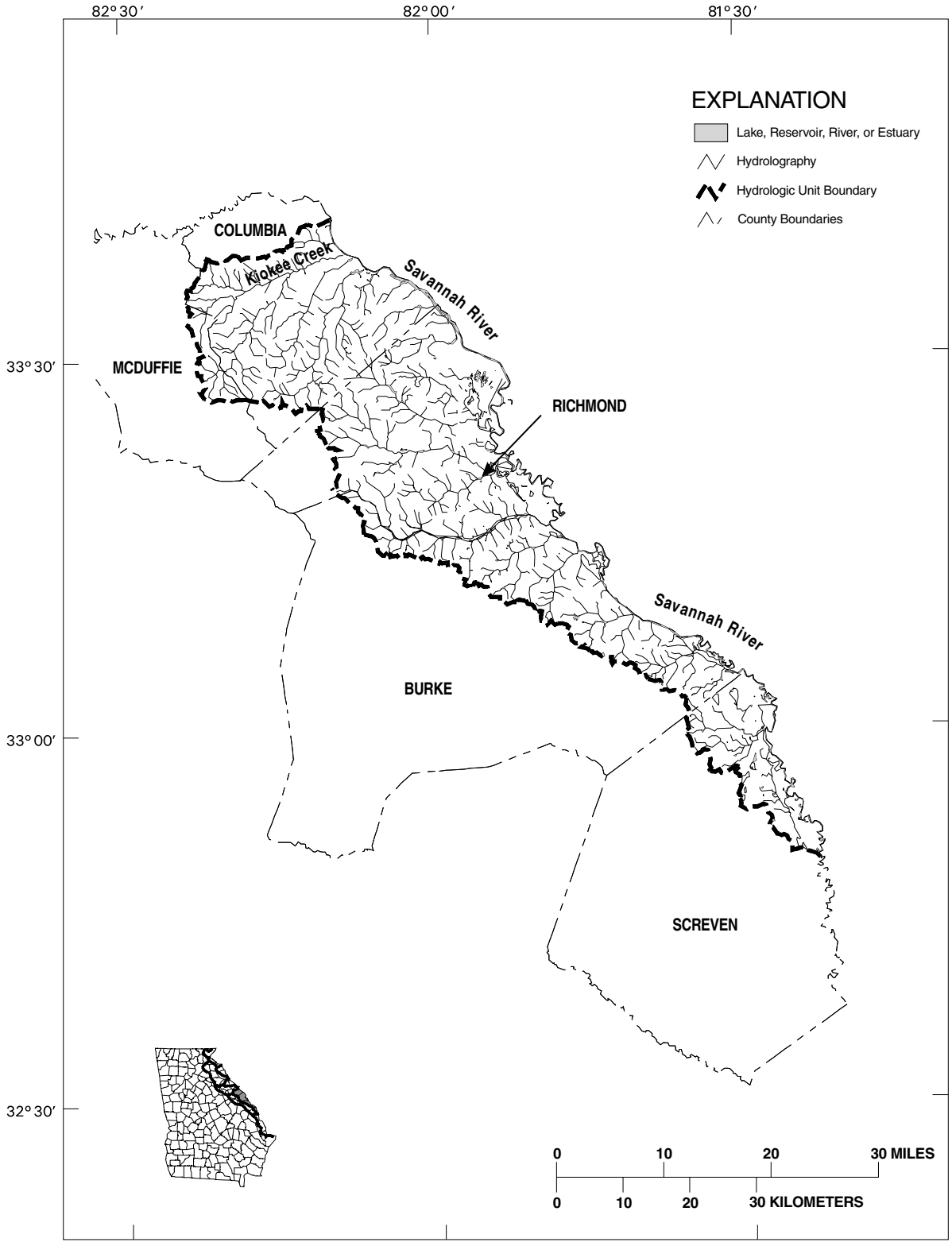

Figure 2-8. Hydrography, Savannah River Basin, HUC 03060106

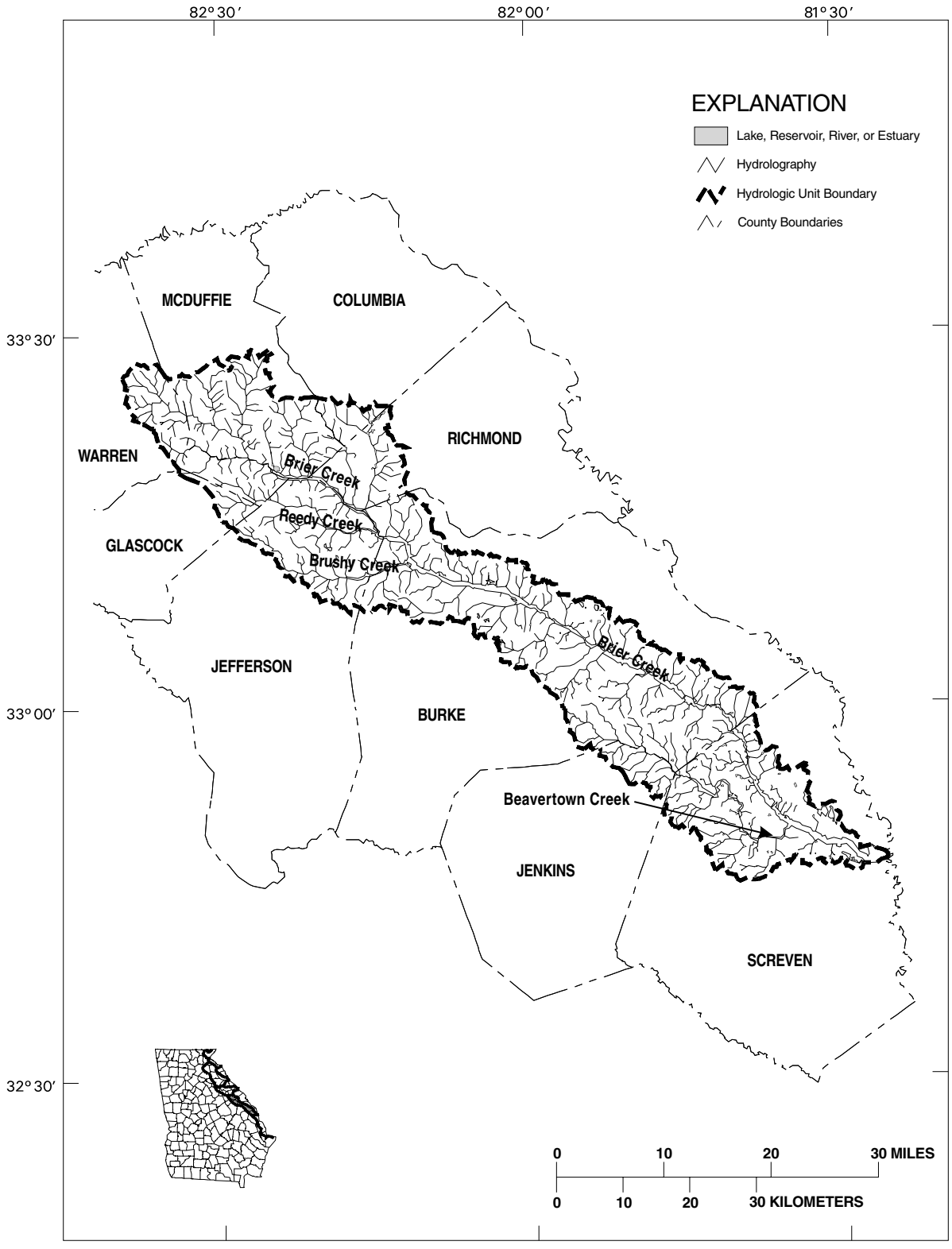

Figure 2-9. Hydrography, Savannah River Basin, HUC 03060108

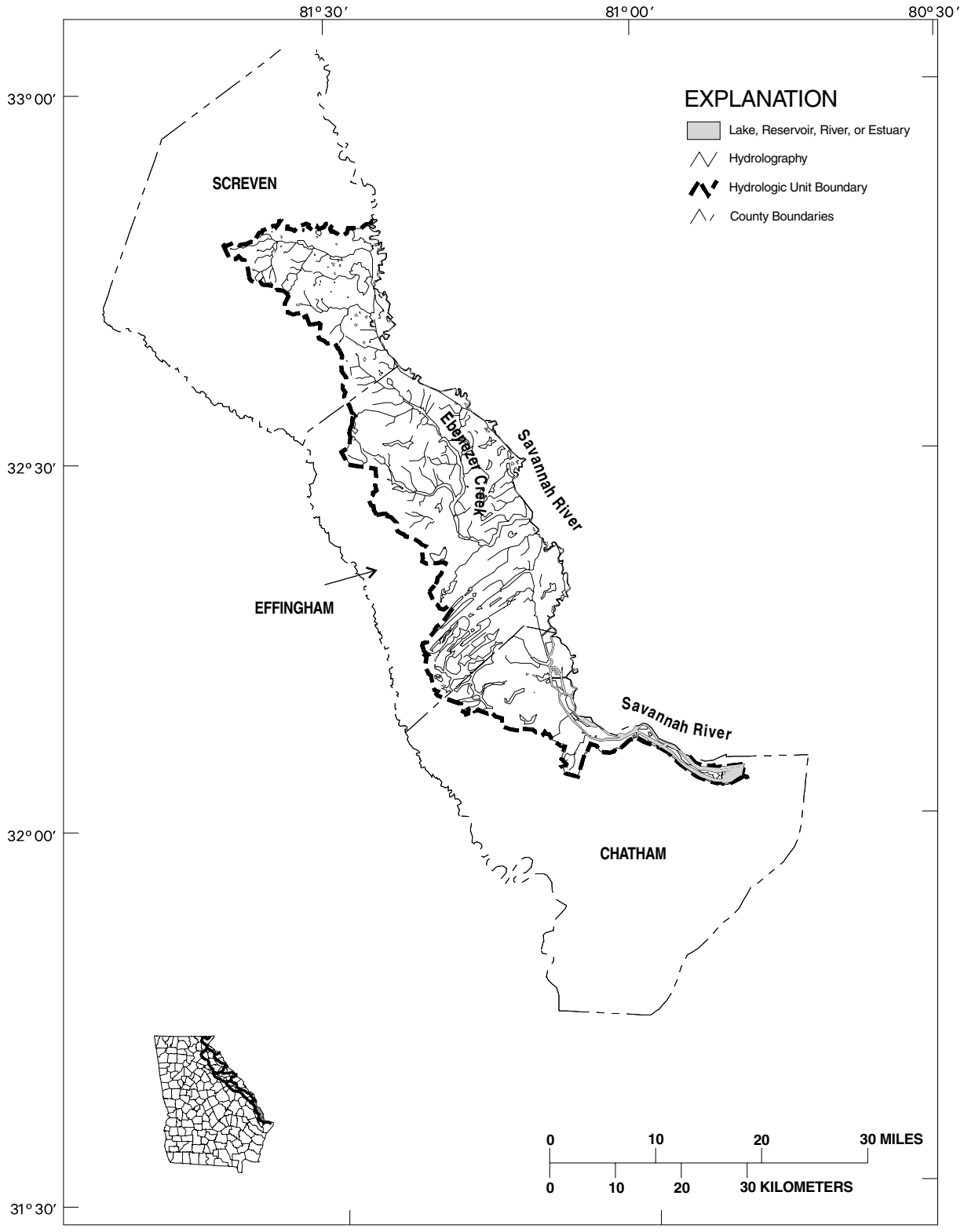

Figure 2-10. Hydrography, Savannah River Basin, HUC 03060109

Middle Savannah River

The middle section of the Savannah River begins downstream of Clarks Hill Dam and ends at Brier Creek. Located partially in the Piedmont Province, but predominately in the upper Coastal Plains, this section of the Savannah River contains the Stevens Creek Reservoir and is fed by numerous small tributaries. It is in this section of the Savannah River that wide flood plains and wetlands begin to emerge.

Brier Creek

Brier Creek is a very long and slender basin with a watershed area of approximately 840 square miles. The creek is characterized by low stream slopes and extensive flood plain and wetland areas.

Lower Savannah River

The lower Savannah River is characterized by black water streams and extensive wetland areas. The Savannah Harbor is a major shipping port and the subject of many studies involving past, present, and future modifications to the harbor.

Reservoirs

There are several large dams on the Savannah River and its tributaries that are used for hydropower generation. U.S. Army Corps of Engineers projects on the Savannah River include Hartwell and Clarks Hill. Georgia Power projects include Burton, Mathis, Nacoochee, Rabun, Tallulah Falls, Terrora, Tugaloo, and Yona. South Carolina Electric and Gas Company also operate the Stevens Creek facility on the Savannah.

The Hartwell Lake project is on the upper Savannah River, 89 miles above Augusta, Georgia, and 7 miles below the confluence of the Tugaloo and Seneca Rivers, which form the Savannah River. Hartwell is the second flood control project built in the Savannah River basin. Construction of the dam was completed in 1963 and spans 18,000 feet. Drainage area above the dam is 2,088 square miles. The area at top of summer conservation pool is (elevation 660 feet msl) - 55,950 acres. Flood control storage is 193,000 acre-feet. Total storage capacity is 2,843,000 acre feet.

The Richard B. Russell project is located on the upper Savannah River, 30 miles downstream from Hartwell Dam and 37 miles upstream from Clarks Hill Dam. Permanent filling of the reservoir began in October 1983 and reached full pool level of 26,650 acres at elevation 475 msl in December 1984. The drainage area above the dam is 2,837 square miles. The area at top of summer conservation pool (Elv. 475 feet msl) is 26,650 acres. Total storage capacity is 1,026,244 acre feet.

The Clarks Hill project is located on the Savannah River, 22 miles above Augusta, Georgia. Thurmond is the first flood control project built in the Savannah River basin. Construction of the dam was completed in 1954 and spans 5, 680 feet. Drainage area above the dam is 6,144 square miles. The area at top of summer conservation pool elevation 350 feet msl is 70,000 acres. Total storage capacity is 2,900,000 acre-feet.

2.I.5 Ground Water Resources

The geology of the Savannah River basin determines the ground water characteristics of the area. Generalized outcrop areas of major aquifers for the Savannah River basin are shown in Figure 2-11. In the Savannah River basin, groundwater occurrence is related to two distinct physiographic provinces. Abundant groundwater supplies are concentrated in

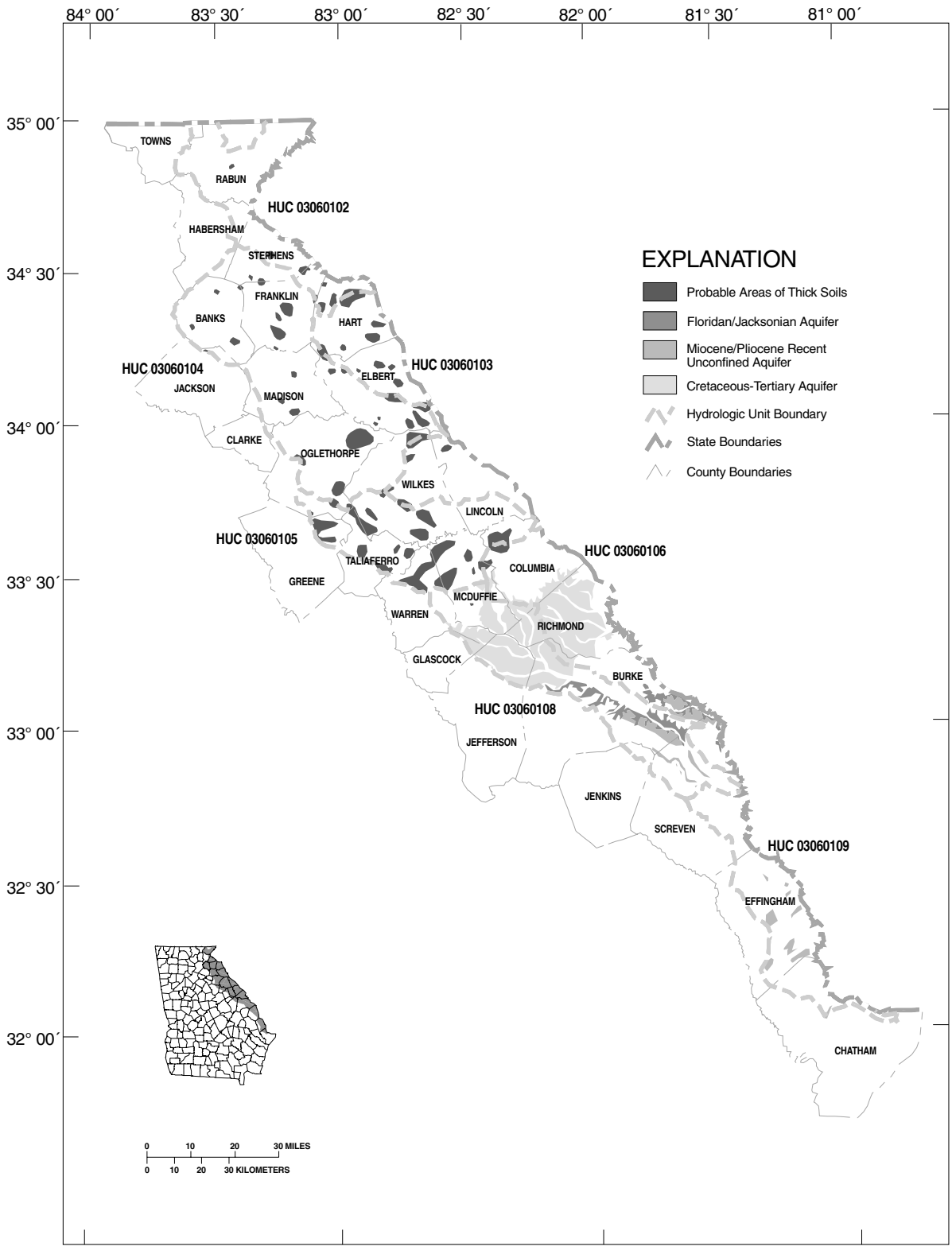

Figure 2-II. Hydrogeologic Units Underlying the Savannah River Basin

the lower half of the basin in the Coastal Plain province. Traveling south in the basin, the areas are as follows:

Crystalline rock aquifers

In the upper half of the basin, from Rabun County south to the Fall Line at Augusta, the crystalline rock formations that underlie the Piedmont province greatly restricts groundwater availability. Some studies have shown that there may be contact zones, fractures, and shear planes capable of producing water yields as high as 400 GPM in the Piedmont, though the common range of production is nearer 50 GPM or less. Some wells have found on the on the order of 1 GPM. Techniques for locating those reliable sources have improved greatly over the past 10 years, and will likely continue to do so.

Cretaceous sand aquifers

The Cretaceous Sand Aquifer system, located along the northern edge of the Coastal Plain, outcrops in a band of terrain about 40 miles wide across the central part of the basin, mainly in Jefferson, Richmond and Burke Counties, are part of the Kaolin Belt of Georgia. Dewatering operations at the clay pits, plus the extensive amount of process water necessary for processing the kaolin can lead to localized drawdowns within the Cretaceous Aquifer. This can mean some domestic wells or other operations can lose the use of their wells. Generally the kaolin companies then redrill or deepen the wells to provide water to the impacted folks. The Cretaceous Aquifer is made up of the Dublin-Midville aquifers, a clastic aquifer containing water in sandy intervals. Overlying this is the Gordon Aquifer, a thin sand and shale unit of Eocene age. The Cretaceous Aquifer consists of interbedded sands and clays that begin at the Fall Line and is as thick as several hundred feet farther to the south. Groundwater occurs in the pore spaces of the somewhat unconsolidated sand layers, which are composed of largely angular to subangular quartz grains. The interbedded clay layers act as confining beds causing the deeper groundwater to occur under artesian conditions. Well yields in the portions of the Cretaceous Sand Aquifer underlying the river basin have been found to exceed 1000 GPM. Recharge occurs through the sandy soil in the outcrop area. In the central portion of the basin this unit is seen as one single aquifer and can be called either the Cretaceous Aquifer or the Dublin-Midville Aquifer. As you move to the south, an intervening clay layer becomes apparent, and divides the Aquifer into two distinct units. Below is the Midville Aquifer of definite Cretaceous age. Overlying the confining shale unit is the Dublin Aquifer, which is of Cretaceous - Early Tertiary age.

Gordon aquifer

The Gordon Aquifer system, of Eocene age, overlies the Cretaceous Sand Aquifer in the Coastal Plain portion of the basin, and consists of saturated permeable sands. It is confined above and below by clay-rich layers, and ranges in thickness from about 20 feet in Richmond County to about 150 feet to the south. Generally well yields of up to 500 GPM are possible in the southern portions of the basin. Gordon Aquifer recharge occurs mainly through the outcrop areas in Jefferson and Richmond Counties.

Floridan aquifer

The Floridan Aquifer underlies the rest of the southern portion of the basin. The aquifer is overlain by about 25-125 feet of sandy clay residuum derived from chemical weathering of the underlying rock. The total thickness of the Floridan Aquifer in the basin ranges from a few tens of feet in the north to more than 400 feet in the extreme southern portion of the basin. Clastic grains of sand and shale comprise the main units in

the northern portions of this aquifer, while to the south the aquifer consists of three thick beds of limestone (i.e., Tampa limestone, Suwannee limestone, and Ocala limestone). Well yields can range from about 40 GPM in the north to more than 10,000 GPM in the thickest, southern most portions of the Floridan Aquifer. The Floridan serves as the main aquifer from Burke County to the coast.

2.1.6 Biological Resources

The Savannah River basin supports a diverse and rich mix of terrestrial and aquatic habitats and is home to a number of federally and state-protected species. The basin encompasses parts of five major land resource areas, with a wide range of elevations and slopes, providing many different habitat types. The northern part of the basin is managed as a part of the Chattahoochee National Forest, which includes a number of wilderness and wildlife management areas. Some of the important biological resources of the basin are summarized below.

Terrestrial Habitats

The headwaters of the Savannah River Basin lie in Bailey's Southeastern Mixed Forest Province of the Subtropical Division, an ecoregion known for its mild winters and hot, humid summers (Bailey, 1995). Characteristic climax vegetation consists of medium-tall to tall forests of broadleaf deciduous and needleleaf trees. Loblolly pine, shortleaf pine, and other southern yellow pine species comprise at least 50 percent of the forest cover, and include associations of oak, hickory, sweetgum, blackgum, red maple, and winged elm. Other vegetation common to this area includes grasses, such as bluestem, panicums, and longleaf uniola, as well as dogwood, viburnum haw, blueberry, American beautyberry, youpon, and numerous woody vines (Bailey, 1995).

The southern portion of the Savannah River basin lies in the Outer Coastal Plain Mixed Forest Province (Bailey, 1995). This is a temperate rainforest (or temperate evergreen forest or laurel forest) ecoregion characterized by having fewer species and larger populations of individual species than equatorial or tropical rainforests. Common species include evergreen oaks and species of the laurel and magnolia families. Typically these habitats include a well-developed lower stratum of vegetation consisting of tree ferns, small palms, shrubs, and herbaceous plants. At the higher elevations, the trunks and branches of trees are often covered in moss. At the lower elevations, trees such as Evangeline oaks, baldcypress and others are covered by the epiphyte commonly known as Spanish moss (Bailey, 1995).

The extensive coastal marshes and interior swamps characteristic of Georgia's coastal region are dominated by gum and cypress. The upland areas are covered by subclimax pine forests, which have an understory of grasses and sedges referred to as savannas. Undrained shallow depressions in savannas form upland bogs or pocosins, in which evergreen shrubs predominate.

Terrestrial Fauna

The Savannah River basin supports a wide diversity of wildlife. The species found throughout the basin vary with the age and stocking of timber stands, percent of deciduous trees, proximity to openings, and presence of bottom-land forest types (Bailey, 1995).

White-tail deer and cottontail rabbits are widespread, fox squirrels are common in deciduous uplands, and gray squirrels are common along drainages. Other common mammals include fox, raccoon, oppossums, flying squirrels, and numerous ground-dwelling rodents.

The primary game birds are the bobwhite quail, eastern wild turkey, and the mourning dove. The most common bird species found in the mature forests include the pine warbler, cardinal, summer tanager, Carolina wren, ruby-throated hummingbird, blue jay, hooded warbler, eastern towhee, and tufted titmouse. The red-cockaded woodpecker, a federally-listed endangered species, is found in mature longleaf pine habitats.

Common reptiles include the cottonmouth, copperhead, rough green snake, rat snake, coachwhip, and speckled kingsnake, numerous lizards and salamanders, and the American alligator.

Aquatic Fauna

Fish Fauna

The Savannah River basin drains over 25,900 km2 (10,000 square miles) of Georgia, North Carolina and South Carolina. The Savannah River forms near Hartwell, Georgia at the confluence of the Seneca and Tugaloo Rivers, and flows southeasterly for 476 km until emptying into the Atlantic Ocean near Savannah, Georgia (Schmitt and Hornsby 1985). The Keowee river and Twelve Mile Creek are the major headwaters streams of the Seneca River. The Tugaloo River is formed by the union of the Tallulah and Chattooga Rivers. These headwater streams originate on the southern slopes of the Blue Ridge Mountains in North Carolina and Georgia.

The diverse fish fauna of the Savannah River basin includes 108 species representing 36 families. Many of the species are in the minnow family Cyprinidae. The largest group of species belongs to the sucker family Catostomidae. The Savannah River basin is dominated by a warm-water fishery. Warm-water species of recreational importance include largemouth bass, chain pickerel, black crappie, channel catfish, striped bass, hybrid (white x striped) bass, white bass, American shad, bluegill, redear sunfish, and redbreast sunfish.

Fisheries

The fish communities of the headwater streams, the Chattooga and Tallulah River systems, change rapidly from coldwater to warmwater species in response to decreasing elevations and increasing water temperatures. Fish populations in the mountain streams are often limited in productivity by naturally low alkalinity, high gradients, flow extremes, and, for coldwater species, high summer water temperatures. Total fish biomass in the upper Savannah basin typically ranges from 27 to 134 lbs/acre and is dominated by the minnow (Cyprinidae) and sucker (Catastomidae) families.

The lower reaches of the Tallulah River and Chattooga River are impounded by a series of hydroelectric dams. The fish fauna within these Savannah River tributary reservoirs is composed of both coolwater and warmwater species. Sunfish (Centrarchidae) and minnows (Cyprinidae) account for nearly one half of the species diversity. In the upper Savannah River basin, at least 50 species of fish representing 11 families have been documented (Table 2-2). Reservoir fish biomass typically ranges from 40 to 120 lbs/acre (Table 2-3).

The two primary species representing the Catostomids in the Savannah River basin are spotted sucker and silver redhorse. Even though suckers are not highly prized by most fishermen, they are ecologically important because they often account for the majority of fish biomass in Georgia streams. In a 1985 survey conducted by the fisheries section of the Georgia Department of Natural Resources on the Savannah River, spotted suckers comprised 21 percent of the total sample by weight. Other families with large numbers of species are the sunfish (Centrarchidae) and the catfish (Ictaluridae) families.

Table 2-2. List of Fishes Captured in Fisheries Surveys of Savannah River Tributaries in Association with FERC Relicensing (Georgia Power 1990) and From GADNR Fish Surveys

Scientific Name	Common Name
Family: Lepisosteidae	Gars
Lepisosteus osseus	Longnose Gar
Family: Clupeidae	Herrings
Dorosoma cepedianum	Gizzard Shad
Dorosoma petenense	Threadfin Shad
Alosa aestivalis	Blueback Herring
Family: Salmonidae	Trouts
Oncorynchus mykiss	Rainbow Trout
Salmo trutta	Brown Trout
Salvelinus fontinalis	Brook Trout
Family: Esocidae	Pikes
Esox niger	Chain Pickerel
Family: Cyprinidae	Carps and Minnows
Campostoma anomalum	Central Stoneroller
Cyprinus carpio	Common Carp
Hybopsis rubrifrons	Rosyface Chub
Nocomis leptocephalus	Bluehead Chub
Notemigonus chrysoleucas	Golden Shiner
Notropis galacturus	Whitetail Shiner
Notropis hudsonius	Spottail Shiner
Notropis lutipennis	Yellowfin Shiner
Notropis niveus	Whitefin Shiner
Notropis zonistius	Bandfin Shiner
Family: Catostomidae	Suckers
Hypentelium nigricans	Northern Hogsucker
Minytrema melanops	Spotted Sucker
Moxostoma anisurum	Silver Redhorse
Moxostoma erythrurum	Golden Redhorse
Moxostoma robustum	Robust Redhorse
Moxostoma rupiscartes	Striped Jumprock
Family: Ictaluridae	Catfishes
Ictalurus brunneus	Snail Bullhead
Ictalurus catus	White Catfish
Ictalurus nebulosus	Brown Bullhead
Ictalurus platycephalus	Flat Bullhead
Ictalurus punctatus	Channel Catfish
Noturus insignis	Margined Madtom
Family: Cottidae	Sculpins
Cottus bairdi	Mottled Sculpin
Family: Percicthyidae	Temperate Basses
Morone chrysops	White Bass
Morone saxatilis	Striped Bass
Morone saxatilis x M. chrysops	Hybrid Bass

Scientific Name	Common Name
Family: Centrarchidae	Sunfishes
Lepomis auritus	Redbreast Sunfish
Lepomis cyanellus	Green Sunfish
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear Sunfish
Micropterus coosae	Redeye Bass
Micropterus dolomieui	Smallmouth Bass
Micropterus punctulatus	Spotted Bass
Micropterus salmoides	Largemouth Bass
Pomoxis annularis	White Crappie
Pomoxis nigromaculatus	Black Crappie
Family: Percidae	Perches
Etheostoma fusiforme	Swamp Darter
Etheostoma inscriptum	Turquoise Darter
Perca flavescens	Yellow Perch
Percina nigrofasciata	Blackbanded Darter
Stizostedion vitreum	Walleye

Table 2-3. Creel Statistics for the Savannah River Tributary Reservoirs Located in Georgia and for Lake Hartwell

Creel Statistic	Burton	Seed	Rabun	Tallulah Falls	Tugaloo	Yonah	Hartwell
Total Biomass (lb./ac)	56	77	45	----	52	----	104
Fishing Effort (hr.)	52,737	11,851	15,359	----	21,575	11,546	584,447
Fish Harvest (no.)	47,940	15,964	11,867	----	29,601	4,765	243,750
Fish Harvest (lb.)	18,772	4,814	4,167	----	9,095	2,410	682,081
Mean Success Rate (fish/hr.)	0.91	1.35	0.77	----	1.37	0.41	0.42
Most Fished-For	Bass	Bass	Bass	----	Bass	Bass	Bass
% of Total Effort	72.4%	34.8%	50.1%		15.7%	38.0%	54.0%
% of Total Harvest	25.8%	1.4%	18.9%		13.6%	21.4%	39.7%
Most Abundant	Bream	Perch	Bream	----	Bream	Bream	Bass
% of Total Harvest	40.3%	60.4%	54.2%		45.2%	56.1%	39.7%

a Creel statistics from Georgia DNR 10-month creel surveys.
b Lake Hartwell creel statistics from South Carolina DNR 12-month creel surveys.
c Total biomass estimates obtained from Georgia DNR cove rotenone samples.

Minnows are small fish that can be seen darting around in streams that are only a few feet wide. Other families with large number of species are the sunfish and black bass family, the sucker family, and the catfish family. Species that have the largest number of individuals living in streams typically are minnows and suckers. These species are often not well known because unlike bass, sunfish, and catfish, people do not fish for them, although certain minnows may be used as bait. Minnows have an important role in the aquatic food chain as prey for larger fish, snakes, turtles, and wading birds.

Suckers can grow to more than one foot long and are named for their down-turned mouths, which they use to vacuum food from stream bottoms. Although suckers are not popular game fish, they are ecologically important because they often account for the largest fish biomass in streams.

Both wild and stocked rainbow trout and brown trout are the principal sport fishes in the upper reaches of both the Tallulah and Chattooga River systems. Several extreme headwater areas contain reproducing populations of native brook trout. Georgia DNR trout stocking records from 1998 indicated that 14 streams in the upper Savannah basin were stocked with approximately 203,200 catchable trout. The majority of this stocking was done in Rabun County. Deepwater releases from Lake Hartwell also provide a tailwater trout fishery, but low dissolved oxygen levels in the tailrace during the summer limit the potential carrying capacity for trout and subsequent fishery.

Mainstream and Tributary Reservoirs

Mainstream Reservoirs

Three large, mainstream impoundments are located on the Savannah River. From an upstream to downstream direction, these include lakes Hartwell, Richard B. Russell, and Clarks Hill. The sport fisheries of these impoundments are dominated by largemouth bass, crappie, catfish, and hybrid bass. Hybrid bass and striped bass are produced at Richmond Hill State Fish Hatchery and stocked as fingerlings into these and other Georgia reservoirs.

Richard B. Russell Lake is a 26,650-acre U.S. Army Corps of Engineers reservoir on the Savannah River in Elbert and Hart counties, Georgia and Abbeville and Anderson counties, South Carolina. Impounded in 1985, this near oligotrophic piedmont reservoir has good fisheries for largemouth bass, black crappie, channel catfish, and bluegill. The dam and lake are authorized for fish and wildlife management, flood control, hydropower, navigation, recreation, water quality, and water supply.

There are several lakes within the Savannah River basin that provide excellent habitat for various freshwater fisheries. The Wildlife Resources Division owns and manages McDuffie Public Fishing Area and Fish Hatchery, a series of 48 ponds on tributaries of the Savannah River in McDuffie County. The 13 ponds, encompassing 125.7 acres, open to public fishing offer excellent fishing for bluegill, channel catfish, and largemouth bass. The hatchery ponds are used to raise largemouth bass, bluegill, redear sunfish, channel catfish, striped bass, and robust redhorse for use in public and private waters management. This multi use facility provides wildlife education through McDuffie Environmental Education Center.

Clarks Hill Lake is a 71,535-acre U.S. Army Corps of Engineers reservoir on the Savannah River in Columbia, Elbert, Lincoln, McDuffie, and Wilkes counties, Georgia and Abbeville and McCormick counties, South Carolina. Impounded in 1952, the dam and lake are authorized for fish and wildlife management, flood control, hydropower, navigation, recreation, water quality, and water supply. This near oligotrophic piedmont reservoir has good fisheries for largemouth bass, black crappie, channel catfish, striped bass, hybrid (white x striped) bass, redear sunfish, and bluegill.

There are approximately six miles of shoal habitat and three lowhead dams in the 36-mile stretch of the Savannah River immediately below Clarks Hill Dam. Just upstream of the Augusta shoals, river water is partially diverted into the Augusta Canal. Water in the canal, used for power and water supply, feeds back into the Savannah River at various locations. This section of the Savannah River and Augusta Canal support good fisheries for bluegill, redear sunfish, redbreast sunfish, largemouth bass, chain pickerel, channel catfish, hybrid (white x striped) bass, yellow perch, and migrating American shad. The state endangered robust redhorse, once thought to be extinct, was found in the Savannah River shoals in 1997. Prior to 1997 the Oconee River basin had the only known native population of this endangered sucker. Robust redhorse stockings are currently directed at the Broad River, a major tributary of the Savannah River.

The portion of the Savannah River below Augusta (SRBA) contains a vital sport fishery dominated by largemouth and striped bass, redbreast sunfish, bluegill and redear sunfish. Other species of lesser importance are channel and white catfish, black crappie and American shad. Striped bass stocks declined precipitously beginning in the mid 1980's due to saltwater encroachment on lower river spawning areas resulting from harbor improvement projects. Striped bass are spawned and raised to intermediate size at Richmond Hill Hatchery for stocking in SRBA each year in an effort to replenish depleted stocks and return them to historical structure and density. The Corps of Engineers and DNR are currently partnering in a Section 1135 environmental restoration project to improve Savannah Back River spawning habitat.

Tributary Reservoirs

Six tributary reservoirs, ranging from 63 to 2,875 acres in size, are located in the Georgia portion of the upper Savannah basin (Table 2-4). From an upstream to downstream direction, these include lakes Burton, Seed, Rabun, Tallulah Falls, Tugalo, and Yonah. The sport fisheries of these impoundments are dominated by sunfish, primarily largemouth bass, spotted bass, and bluegill, and yellow perch (Table 2-2). Other less important sport fishes include black crappie, white catfish, channel catfish, walleye, and white bass. Significant fisheries management effort in lakes Burton, Seed, and Rabun is directed toward establishing and maintaining walleye populations. To date, efforts to develop a self-sustaining walleye population have experienced limited success due to increased sedimentation within walleye spawning areas that are located in tributary streams and tailwater areas (Rabern, 1989). Efforts to maintain walleye populations are currently directed at fingerly stocking (Rabern, 1998).

Table 2-4. Physical Characteristics of Savannah River Tributary Reservoirs in Georgia and for Lake Hartwell

Feature	Burton	Seed	Rabun	Tallulah Falls	Tugalo	Yonah	Hartwell
Area (ac.)	2,875	240	834	63	597	325	56,000
Feature Shoreline Length (miles)	62	13	25	3.6	18	9	962
Reservoir Length (miles)	9.5	4.5	9.5	3	5	2.5	41
Area (ac.) Maximum Depth (ft.)	125	48	99	115	142	80	180
Mean Depth (ft.)	----	----	----	----	----	----	46
Shoreline Length (miles) Volume (ac.-ft.)	108,000	8,250	31,250	2,450	43,000	10,200	2,843,000
Elevation (msl)	1,867	1,753	1,690	1,500	892	744	660
Reservoir Length (miles) Drainage Area (miles2)	118	136	151	1860	464	470	10,579
Generating Capacity (MW)	8.3	5.2	15.1	63.4	45.5	24.2	87.5
Maximum Depth (ft.) Impoundment Date	1919	1926	1925	1912	1922	1925	1962

Threatened and Endangered Species

There are 18 federally-listed species in the Savannah River basin—five are federally-threatened and 13 are federally-endangered. In addition, there are 55 species that are either state-listed or of special concern. Of these state-listed species, 20 are threatened, 21

are endangered, 10 are considered rare, and 4 are listed as unusual and deserving of special consideration.

2.2 Population and Land Use

2.2.1 Population

As of 1995, there were 523,100 people in the Savannah River basin (DRI/McGraw-Hill, 1996). Population distribution in the basin at the time of the 1990 census by census blocks is shown in Figure 2-12. By the year 2050, this will have increased by almost 60 percent to 900,000 people. It is estimated that the Savannah Basin will become home to a growing share of Georgia's elderly. The region's coastal location will enable it to attract a growing retirement community, and will provide rising demand for age-friendly products and services.

2.2.2 Employment

The Georgia portion of the Savannah River basin supported 210,000 jobs in 1995, dominated by a variety of trade, service, government, and manufacturing interests.

Over the last two decades, as employment in Georgia grew at an average annual rate of 3.0 percent, employment growth in Savannah fell behind at 2.7 percent, leading to a decline in Savannah's share of the state nonfarm employment from its 7.2 percent in 1975. The situation is unlikely to improve over the next 25 years, as a decline to by .5 percent of state employment over the next five years is not expected to post a turn-around until well into the 2000 century. By 2050, as Savannah's employment growth exceeds that state average, the county's share of state employment is expected to rise to 6.8 percent.

Over the last 20 years, the manufacturing sector has managed to create only 4,800 jobs in the Savannah River basin. The durables sector created 4,700 of these jobs, leaving the food processing industry to post a net decline in employment of 600 positions, and the textiles industry to lose 1,500 jobs. Stronger job creation was noted in the paper industry, which now employees 1,700 more people than two decades ago. In reality with 84,00 new jobs in Savannah since 1975, the manufacturing sector can be seen to have contributed very little. In fact, the poor showing in job creation in Savannah falls behind the state average, taking the region from 8.9 percent of Georgia's manufacturing employment in 1975, to 7.8 percent in 1995. Where job creation has arisen over the last two decades, has been in the services sector. This growth has been led by a substantial rise in the community, business and personal services sector, which over the last decade posted an average annual growth rate of 5.9 percent. The trade sector sat far behind, as its employment grew on average 4.1 percent per annum, followed by transportation, communications and utilities at 3.5 percent a year. Although growth in employment in Savannah's trade and transportation, communication and services sector out paced the state over the last 20 years, the relatively slow growth in the government and finance, insurance and real estate sectors managed to drop Savannah's share of state employment in services from 6.5 percent in 1975 to 6.2 percent in 1995. Over the next 25 years, Savannah's share of employment in Georgia's services sector is expected to remain fairly constant. By 2050, however, the region's share of state employment in services will have advanced to 6.7 percent, as growth in most of Savannah's services industries out paces the state average. The services sector is expected to benefit from an above state average increase in the over-65 population which will provide considerable demand for services.

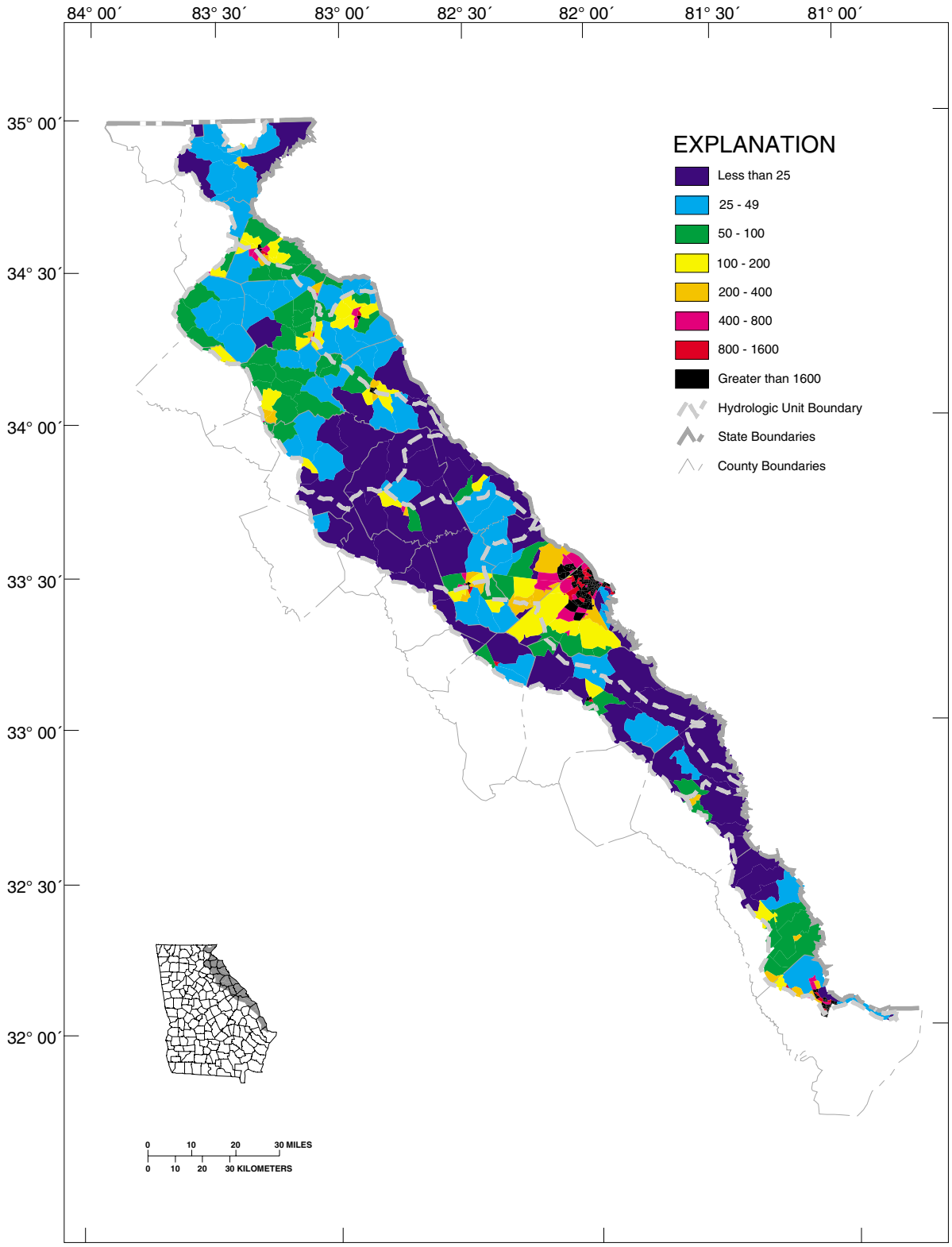

Figure 2-12. Population Density in the Savannah River Basin, 1990

Consistent with its share of state population, 7.5 percent of occupied housing units in Georgia are located in Savannah. The region actually has an above average share of the single housing units in the state, accounting for 8.0 percent of all single units in Georgia. Over the next 25 years, there will be little discernible difference in the rate of construction of single and multiple units in Savannah. Once the baby-boom generation moves into their retirement years, there will be a rising demand for the lower maintenance multi-family housing dwellings. Although there is expected to be a shift in the composition of the housing stock in Savannah over the 2020-to-2050 period, the amount of housing stock will reflect the general increase in the region's population. (DRI McGraw Hill, 1996).

2.2.3 Land Cover and Use

Land use/land cover classification was determined for the Savannah River Basin based on high-altitude aerial photography for 1972-76 (U.S. Geological Survey, 1972-78). Subsequently in 1991 land cover data were developed based on interpretation of Landsat TM satellite image data obtained during 1988-90, leaf-off conditions. These two coverages differ significantly. Aerial photography allows identification of both land cover and land uses. Satellite imagery, however, detects primarily land cover, and not land use, such that a forest and a wooded subdivision may, for instance, appear similar. Satellite interpretation also tends to be less accurate than aerial photography.

The 1972-76 classification (Figures 2-13 through 2-19) indicates that 69 percent of the basin land areas was forest, 18 percent agriculture, 9 percent wetlands, and 2 percent urban.

The 1988-90 land cover interpretation showed 56.9 percent of the basin in forest cover, 8.9 percent in wetlands, 2.1 percent in urban land cover, and 8.8 percent in agriculture (Figures 2-20 through 2-26). Statistics for 15 landcover classes in the Georgia portion of the Savannah basin for the 1988-90 coverage are presented in Table 2-5 (GA DNR, 1996).

Forestry

Forestry is a major part of the economy within the basin. Markets for forest products afford landowners excellent investment opportunities to manage and sell their timber, pine straw, naval stores, etc., products. Statewide, the forest industry output for 1997 grew to approximately $19.5 billion dollars. The value added by this production, which includes wages, profits, interest, rent, depreciation and taxes paid into the economy reached a record high $9.3 billion dollars. Georgians are benefitted directly by 177,000 job opportunities created by the manufacture of paper, lumber, furniture and various other wood products as well as benefitting the consumers of these products. Other benefits of the forest include hunting, fishing, aesthetics, wildlife watching, hiking, camping and other recreational opportunities as well as providing important environmental benefits such as clean air and water and wildlife habitat.

According to the US Forest Service's Forest Statistics for Georgia, 1989 report (Thompson, 1989), there is approximately 2,420,300 acres of commercial forest land in the basin. Private landowners account for 64 percent of the commercial forest ownership while the forest industry companies account for 23 percent. Governmental entities account for about 13 percent of the forest land. Figure 2-27 depicts silvicultural land use in the Savannah basin. Forestry acreage in the Savannah River basin is summarized in Table 2-6.

The pine type is composed of 315,900 acres of planted pine and 705,100 acres of natural pine stands.

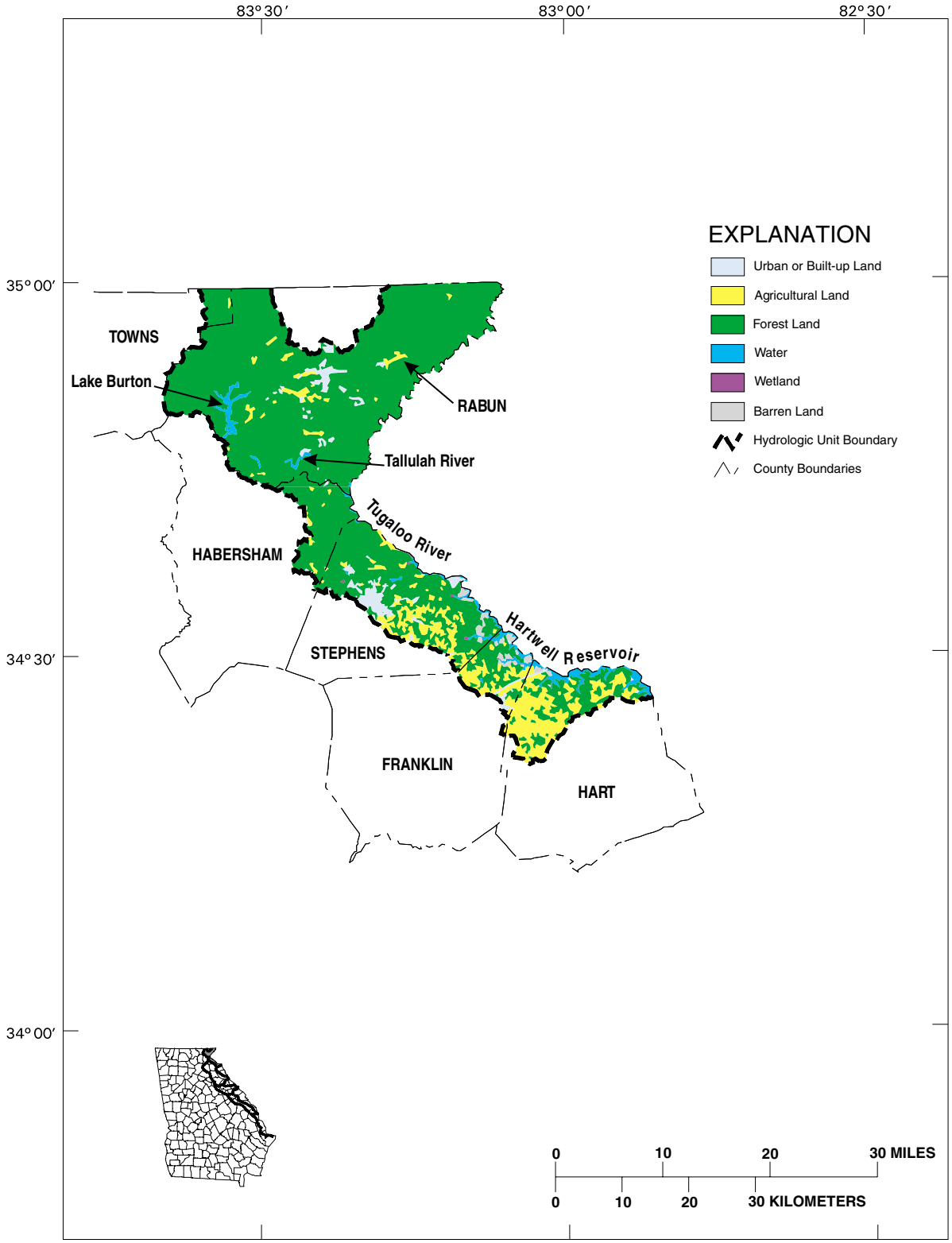

Figure 2-13. Land Use, Savannah River Basin, HUC 03060102, USGS 1972-76 Classification Updated with 1990 Urban Areas

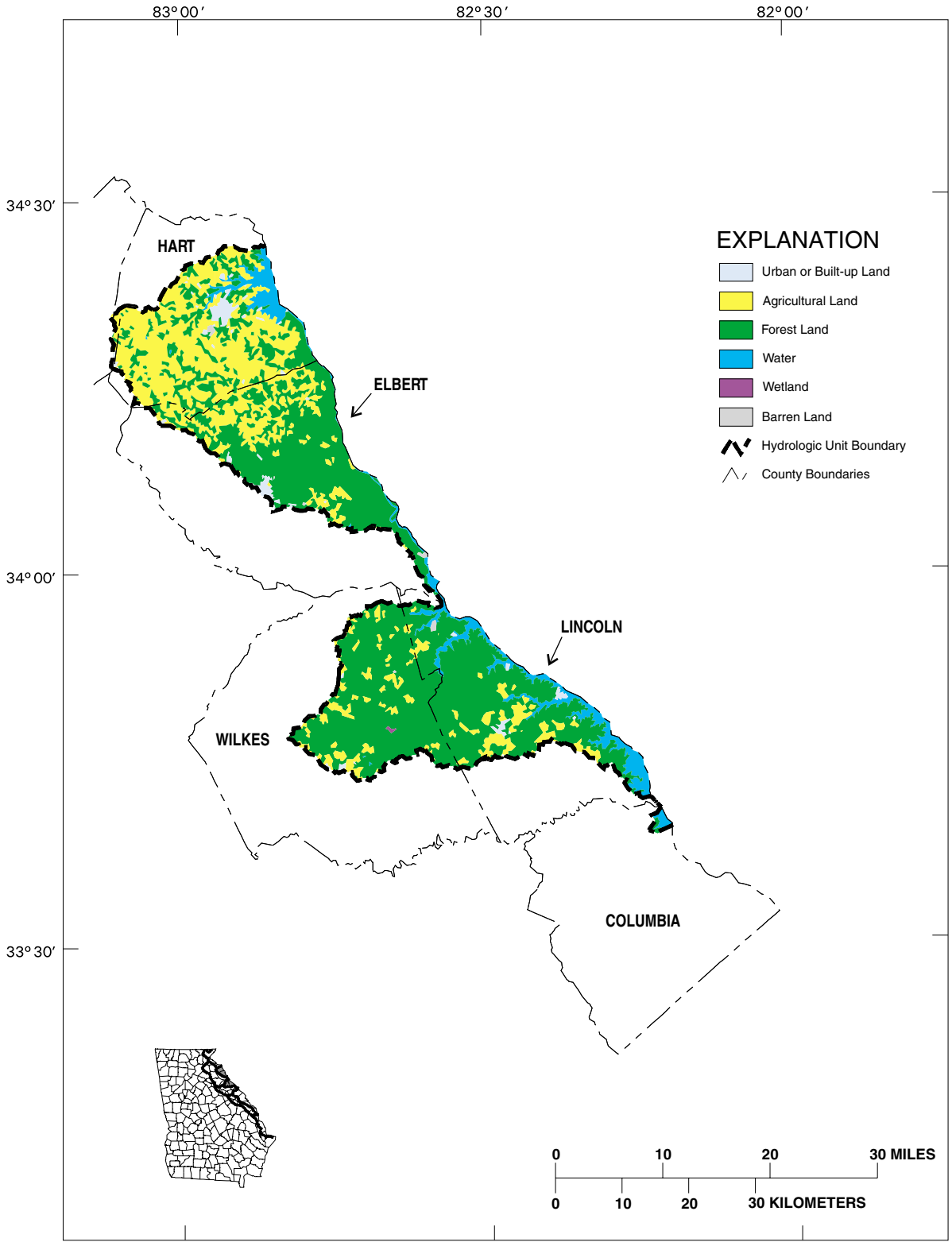

Figure 2-14. Land Use, Savannah River Basin, HUC 03060103, USGS 1972-76 Classification Updated with 1990 Urban Areas

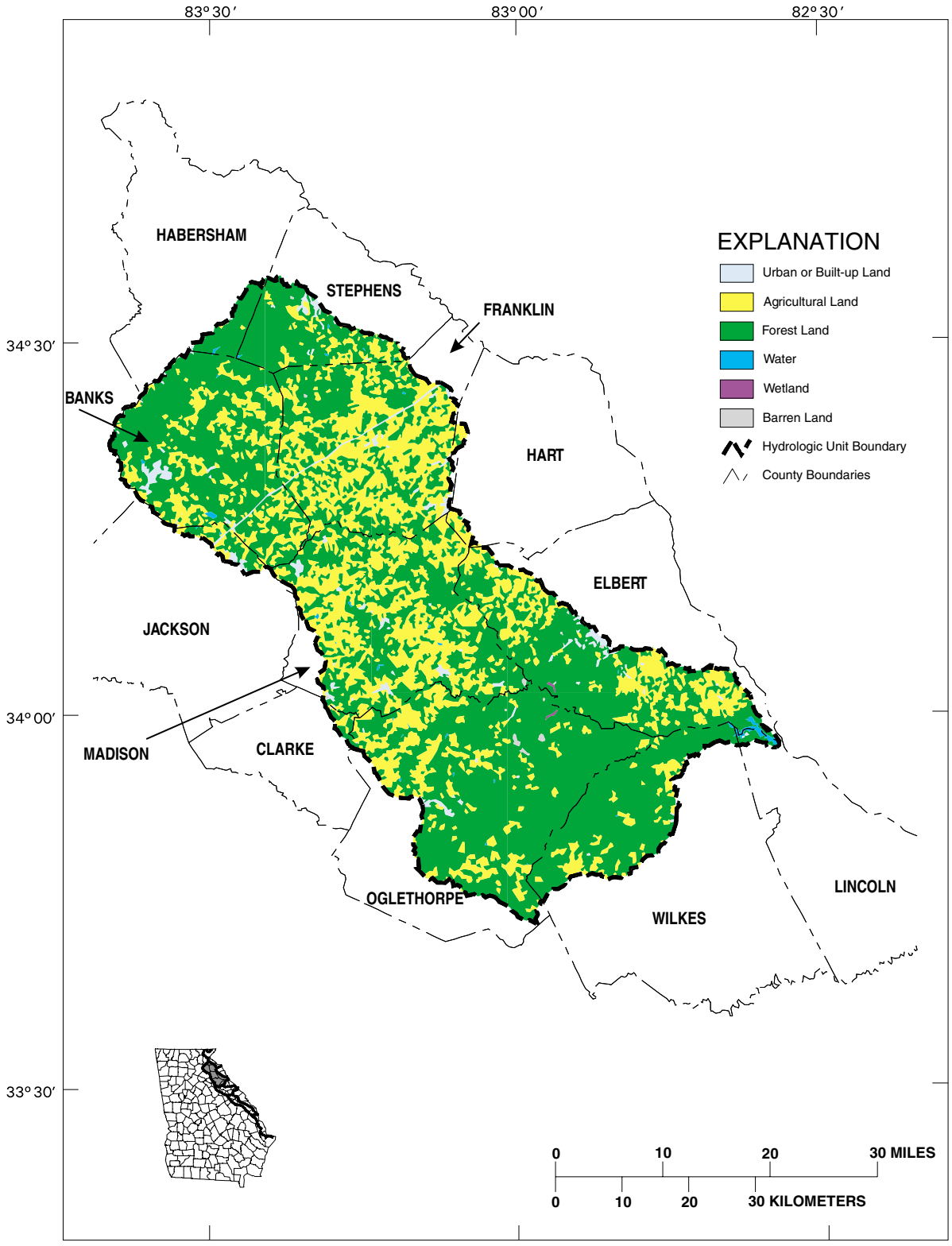

Figure 2-15. Land Use, Savannah River Basin, HUC 03060104, USGS 1972-76 Classification Updated with 1990 Urban Areas

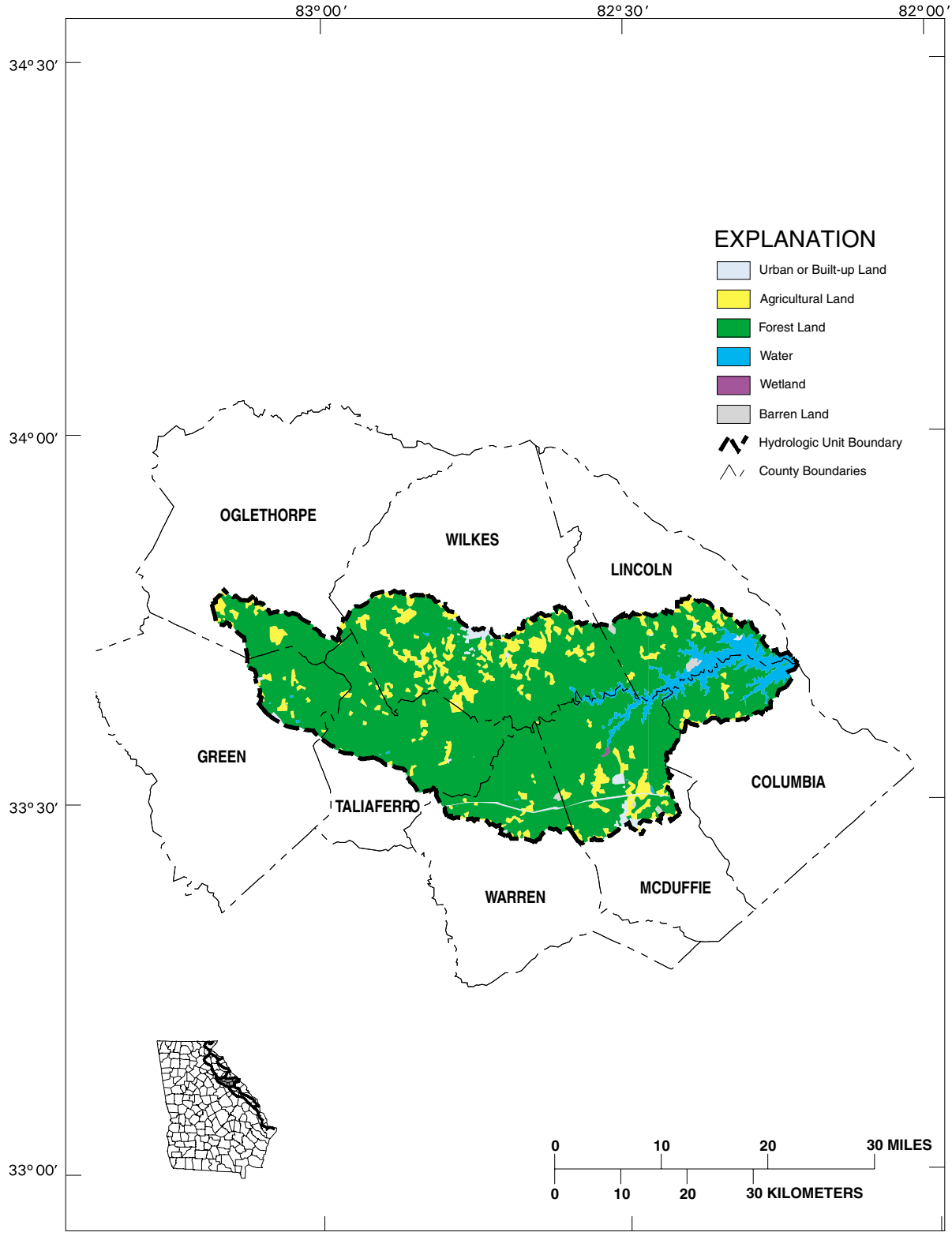

Figure 2-16. Land Use, Savannah River Basin, HUC 03060105, USGS 1972-76 Classification Updated with 1990 Urban Areas

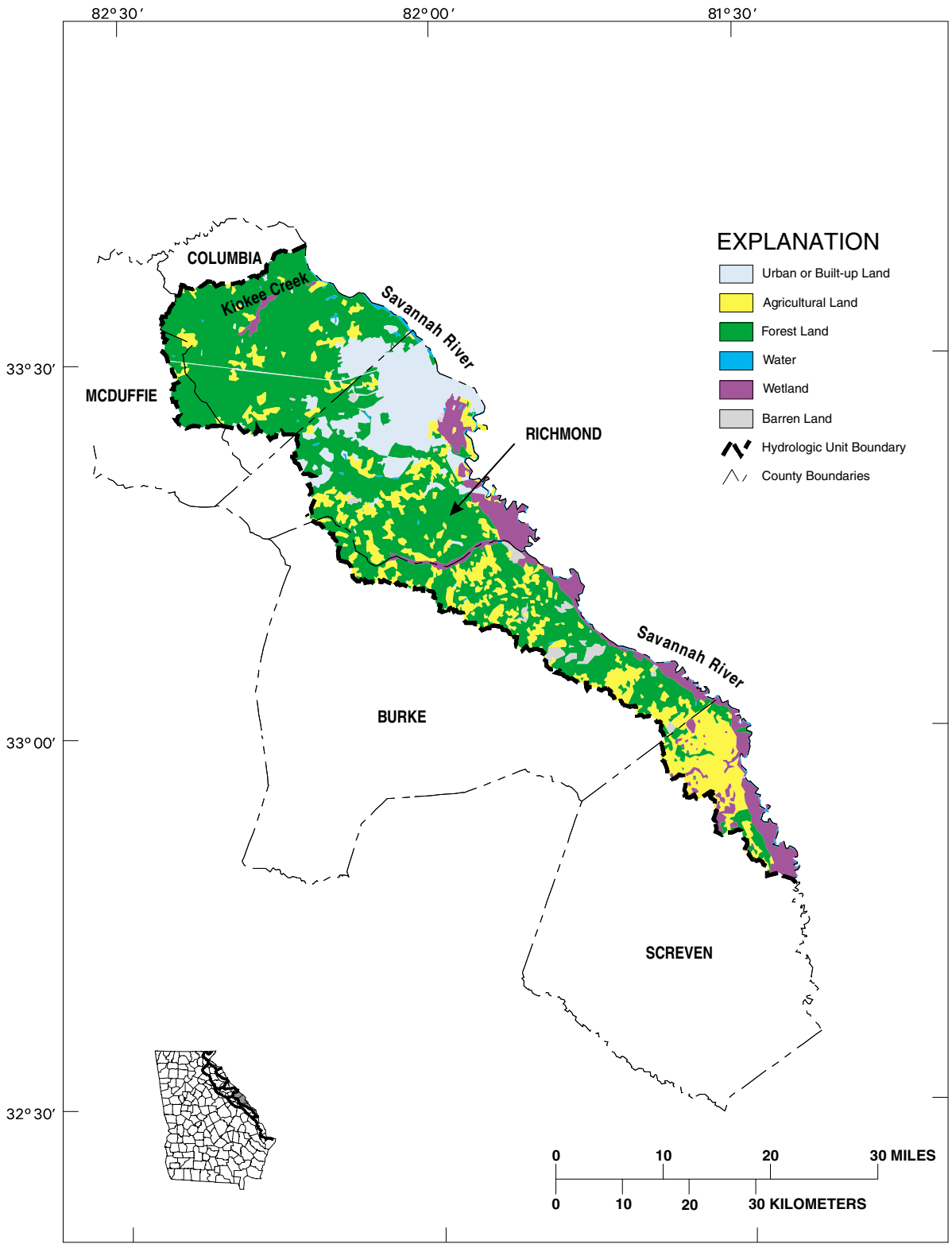

Figure 2-17. Land Use, Savannah River Basin, HUC 03060106, USGS 1972-76 Classification Updated with 1990 Urban Areas

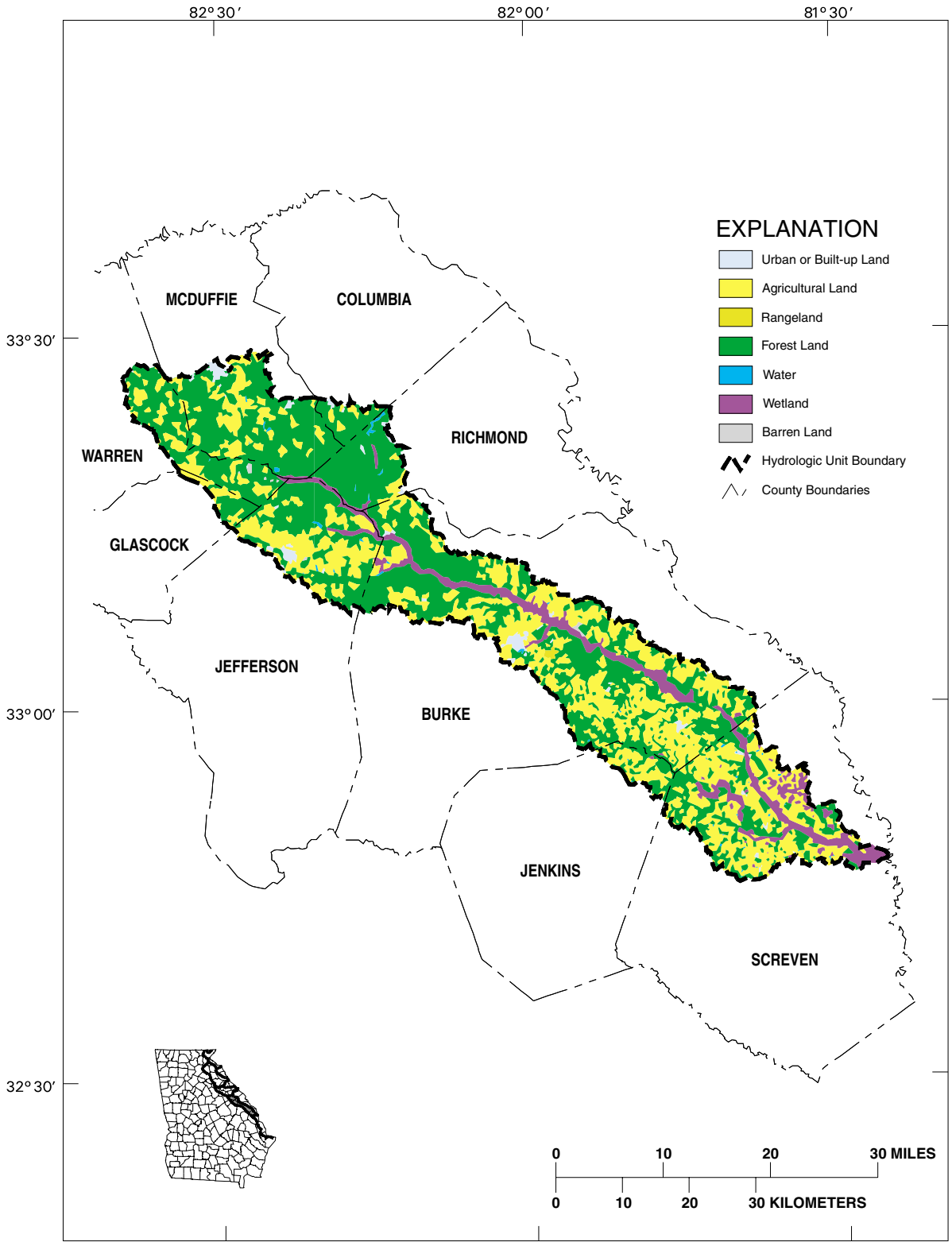

Figure 2-18. Land Use, Savannah River Basin, HUC 03060108, USGS 1972-76 Classification Updated with 1990 Urban Areas

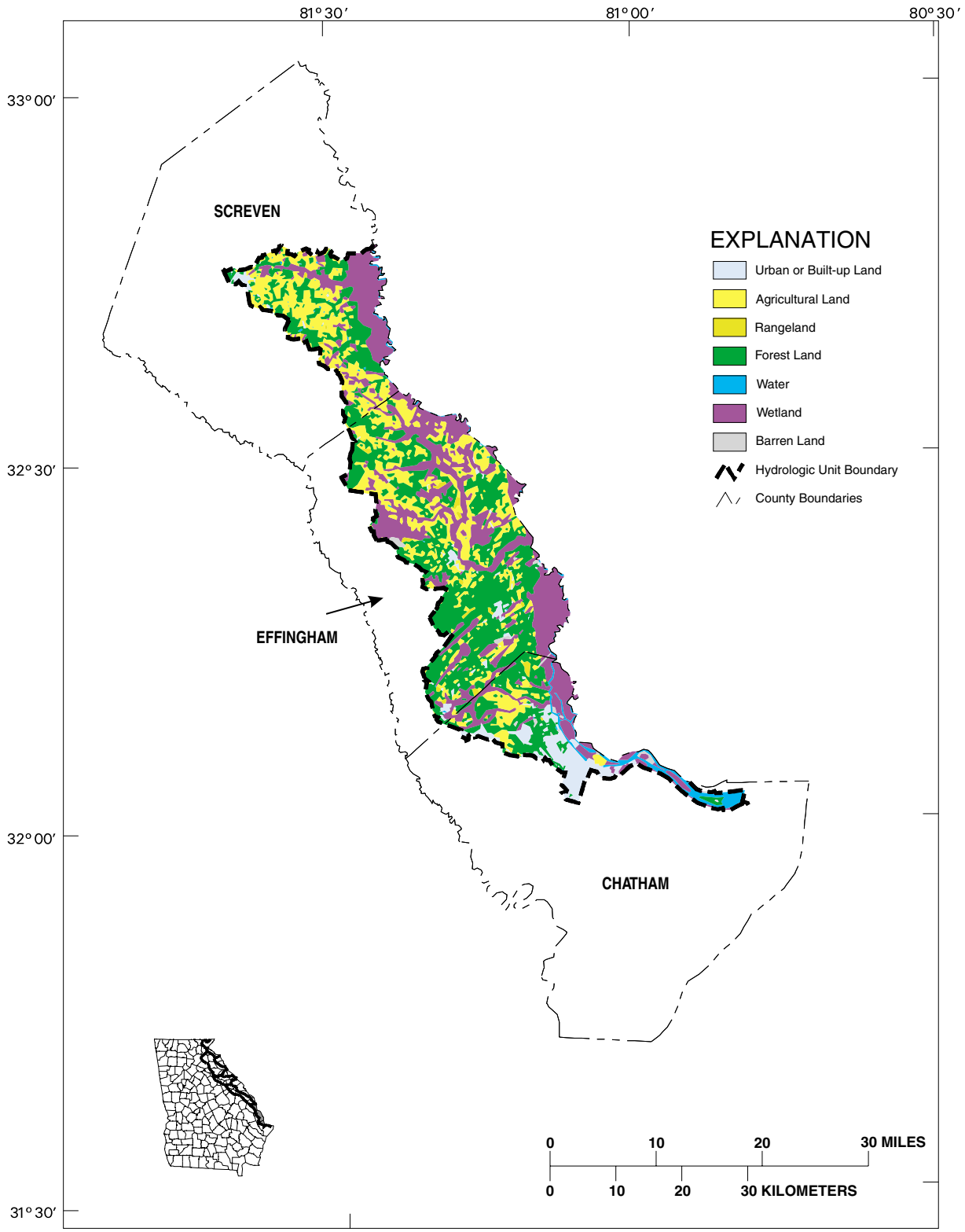

Figure 2-19. Land Use, Savannah River Basin, HUC 03060109, USGS 1972-76 Classification Updated with 1990 Urban Areas

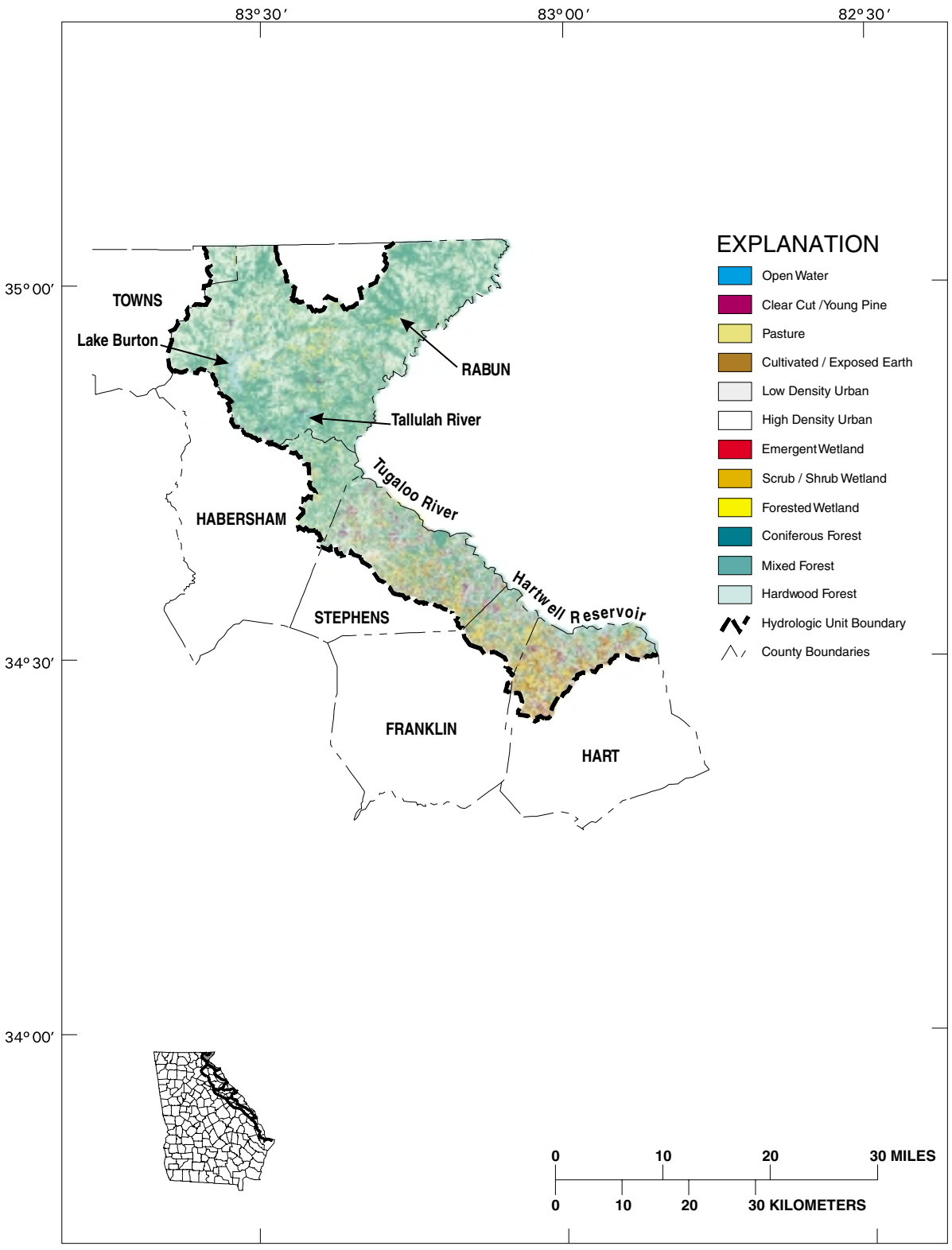

Figure 2-20. Land Cover 1990, Savannah River Basin, HUC 03060102

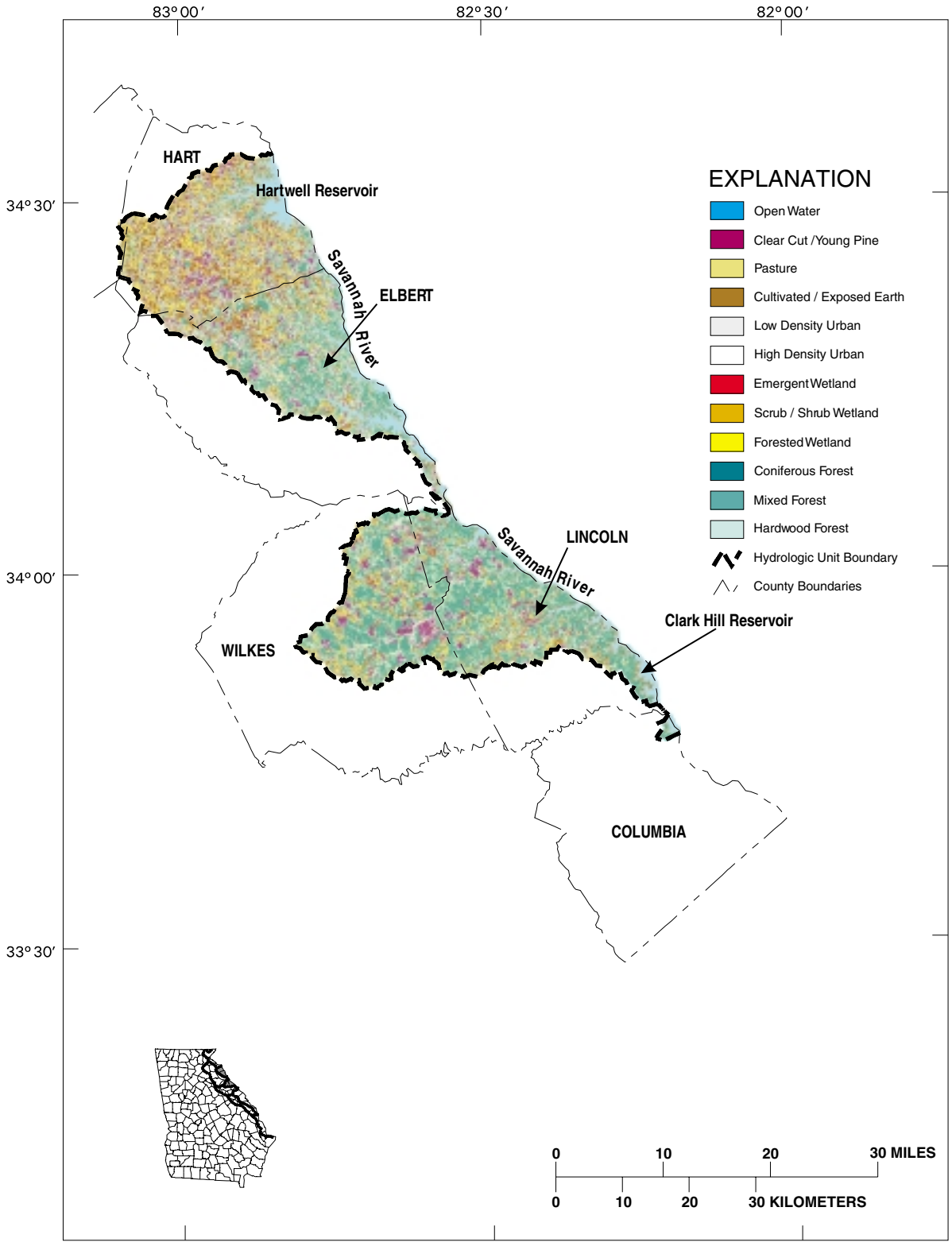

Figure 2-21. Land Cover 1990, Savannah River Basin, HUC 03060103

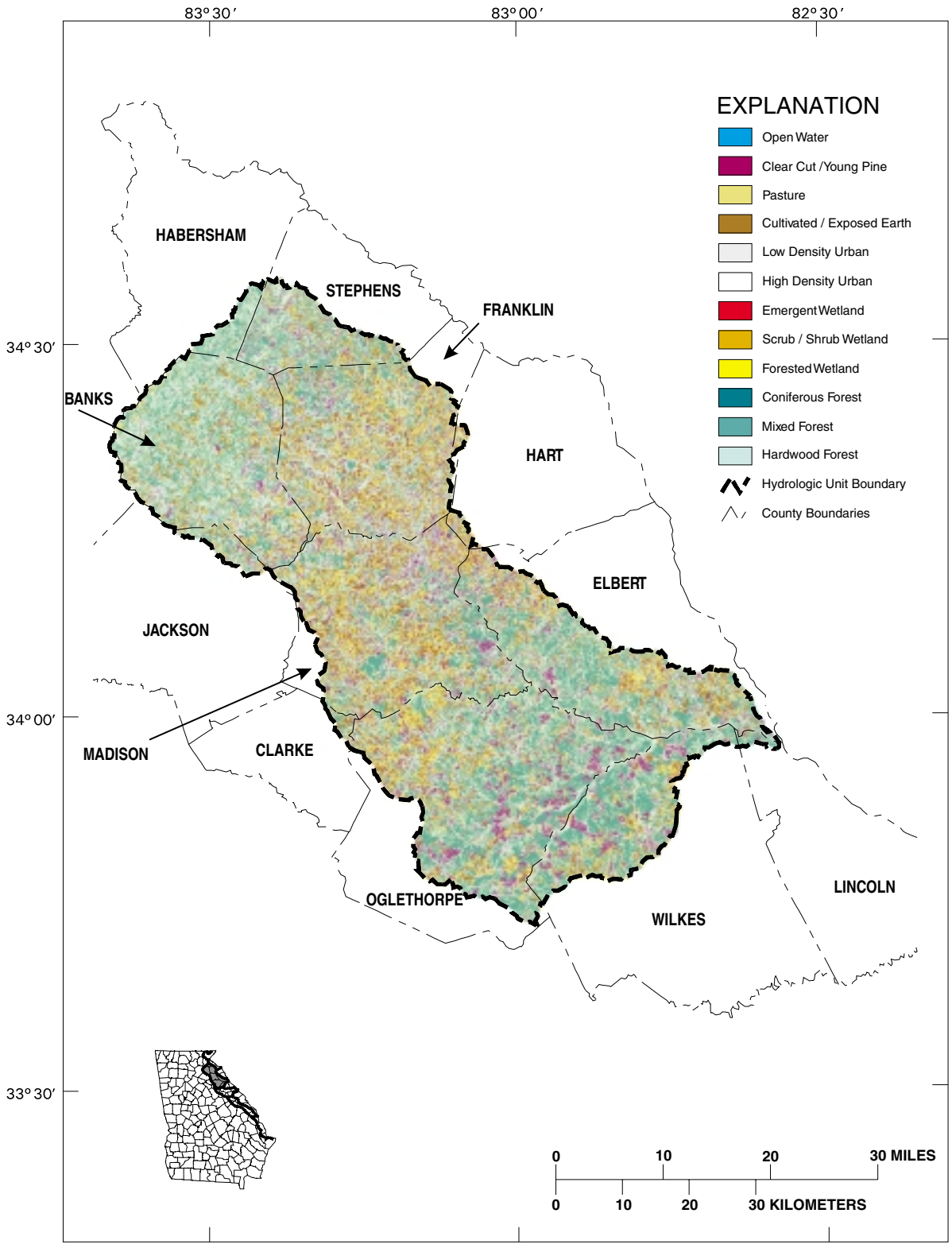

Figure 2-22. Land Cover 1990, Savannah River Basin, HUC 03060104

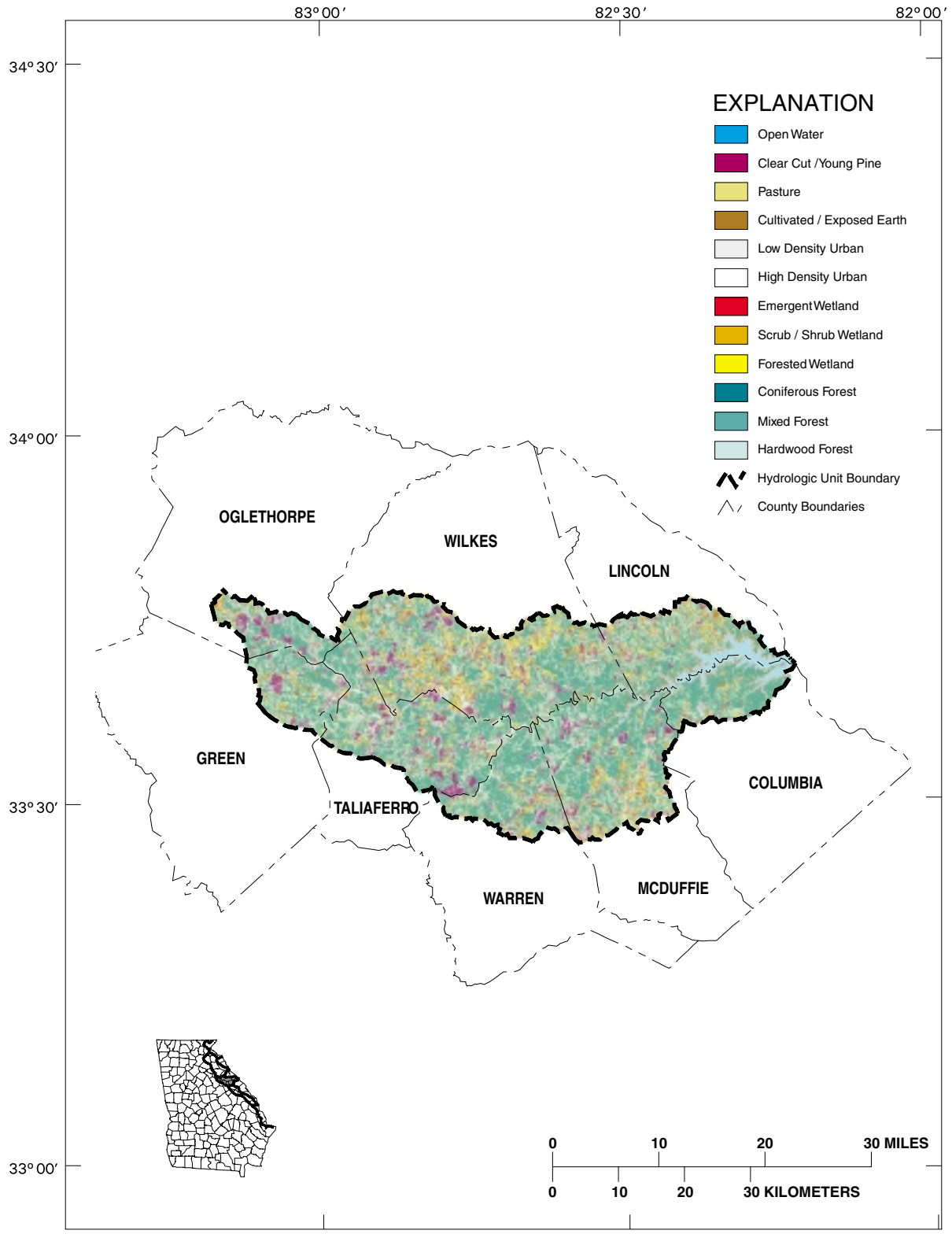

Figure 2-23. Land Cover 1990, Savannah River Basin, HUC 03060105

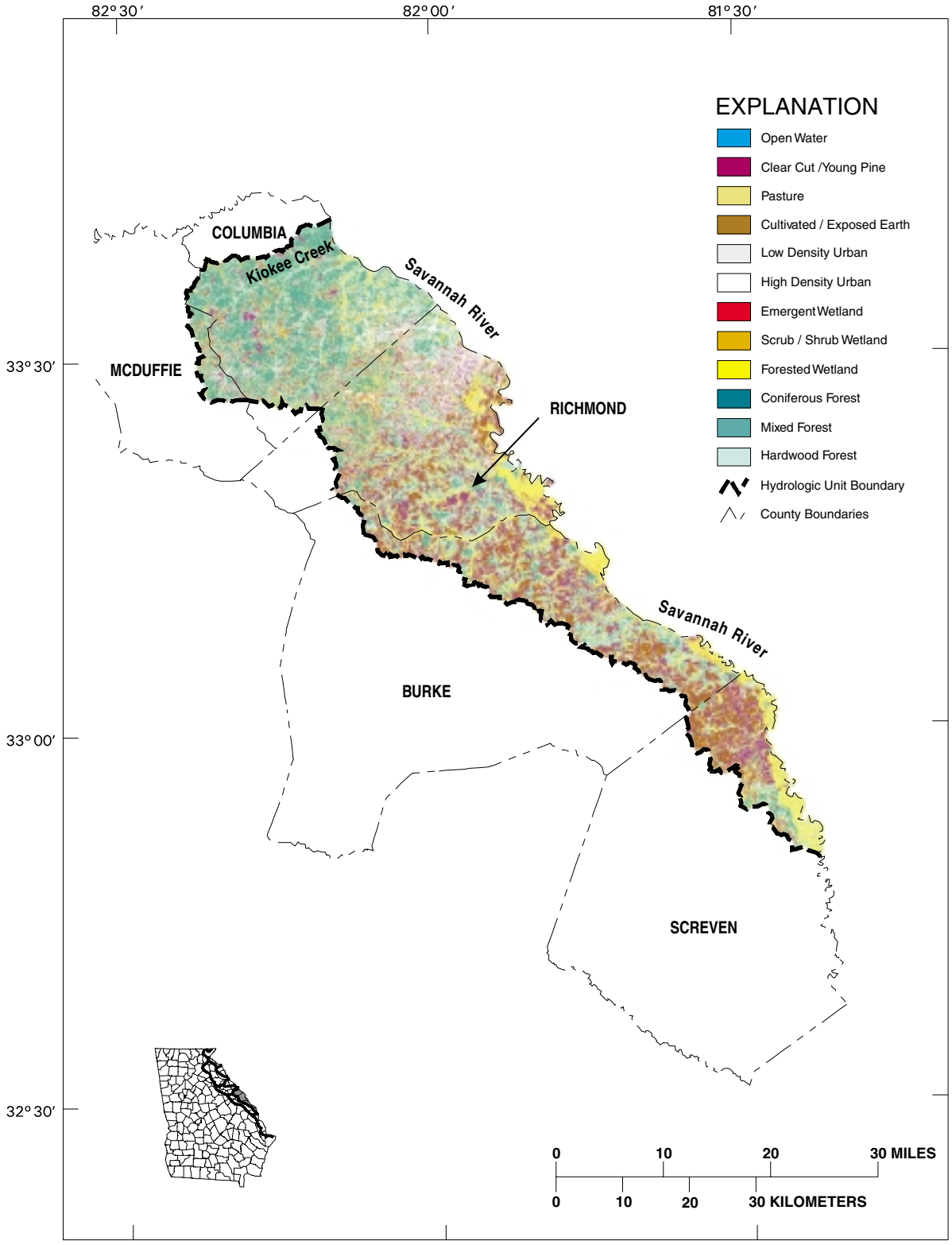

Figure 2-24. Land Cover 1990, Savannah River Basin, HUC 03060106

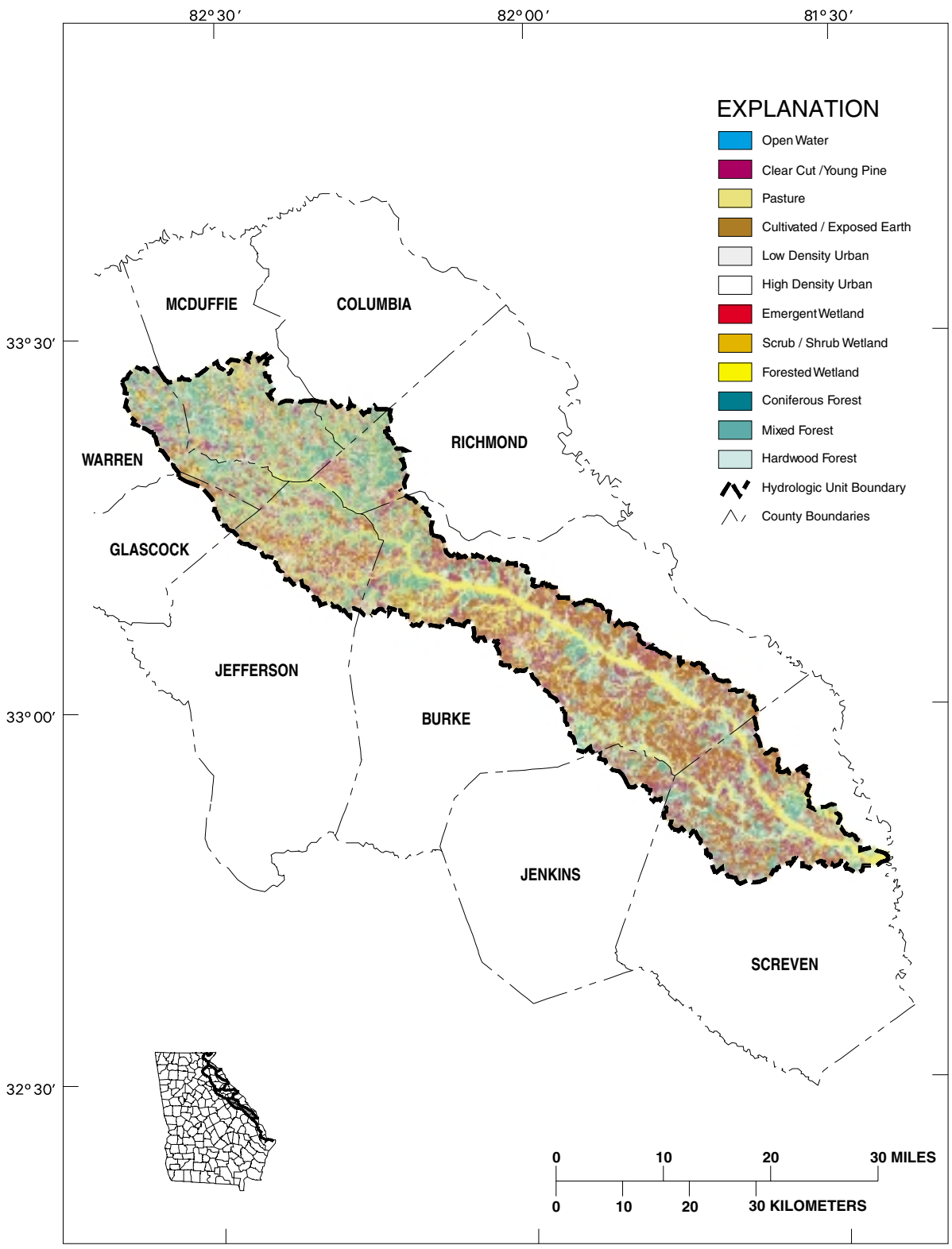

Figure 2-25. Land Cover 1990, Savannah River Basin, HUC 03060108

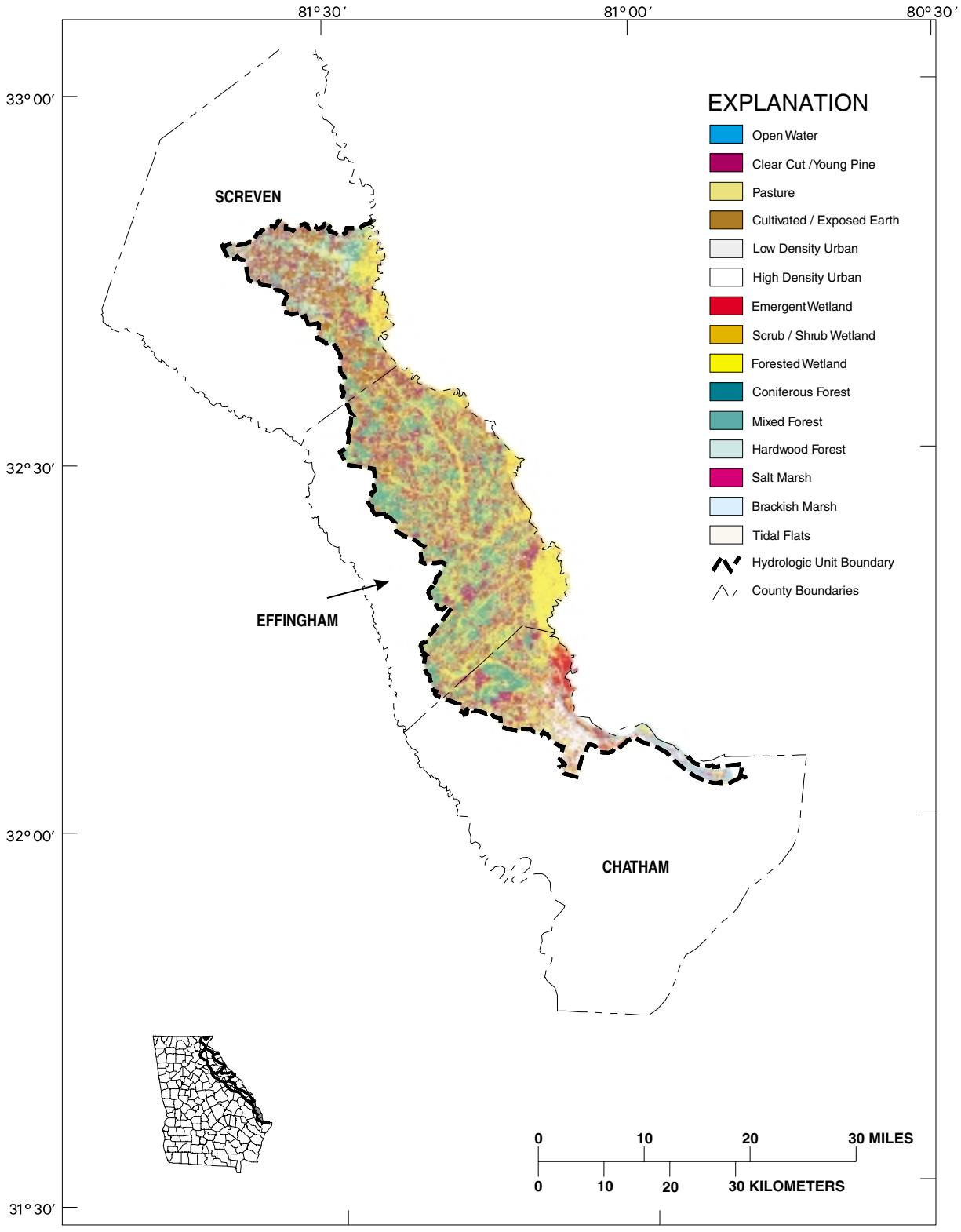

Figure 2-26. Land Cover 1990, Savannah River Basin, HUC 03060109

Table 2-5. Land Cover Statistics for the Savannah Basin

Class Name	%	Acres
Open Water	2.1	76,464.0
Clear Cut/Young Pine	11.7	431,685.9
Pasture	9.2	336,547.8
Cultivated/Exposed Earth	8.8	323,285.1
Low Density Urban	1.5	55,855.1
High Density Urban	0.6	21,404.1
Emergent Wetland	0.5	17,908.3
Scrub/Shrub Wetland	0.5	16,434.4
Forested Wetland	7.9	289,074.6
Coniferous Forest	21.0	771,403.5
Mixed Forest	18.0	663,618.0
Hardwood Forest	17.9	656,838.3
Salt Marsh	0.1	1,869.6
Brackish Marsh	0.0	1,500.5
Tidal Flats/Beaches	0.0	387.5
Total	*99.8*	*3,664,276.70*

Agriculture

Agriculture in the Savannah River basin is a varied mixture of animal operations and commodity production. In general, animal operations are concentrated north of the Fall Line and commodity production is concentrated south of the Fall Line.

Total farmland in the basin, approximately 797,183 acres (Figure 2-28), has declined rather steadily since 1982. Almost 75 percent of the farmland is in pasture. The remaining 25 percent is dedicated to growing cotton, peanuts, tobacco, and small grain [wheat, sorghum, soybean, millet]. Commodity producers applied an averaged of 7.25 inches per acre of supplemental irrigation to over 32,000 acres during 1995. Burke and Jefferson Counties contain the largest number of irrigated acreage in the basin. Irrigation application, along with the number of acres actually harvested among these crops, varies from year to year in response to market conditions, government subsidy and conservation programs, and weather.

Livestock and poultry production is relatively intense in the Savannah River basin. Approximately 202,000 head of cattle, 83,000 head of swine, and 265,000,000 broilers and layers are raised on animal operations in the basin (Table 2-7). Poultry production is especially intense in Banks, Franklin, Hart, Madison , Oglethorpe, and Stephens Counties; with Banks, Franklin, and Madison Counties ranking among the top ten poultry producing counties in Georgia. With respect to cattle production, Franklin, Hart, Madison, and Wilkes Counties collectively are raising over 97,000 head of cattle ranking them among Georgia's top ten cattle producing counties. Oglethorpe County leads the basin with approximately 31,000 head of swine, which ranks them 5th in the state.

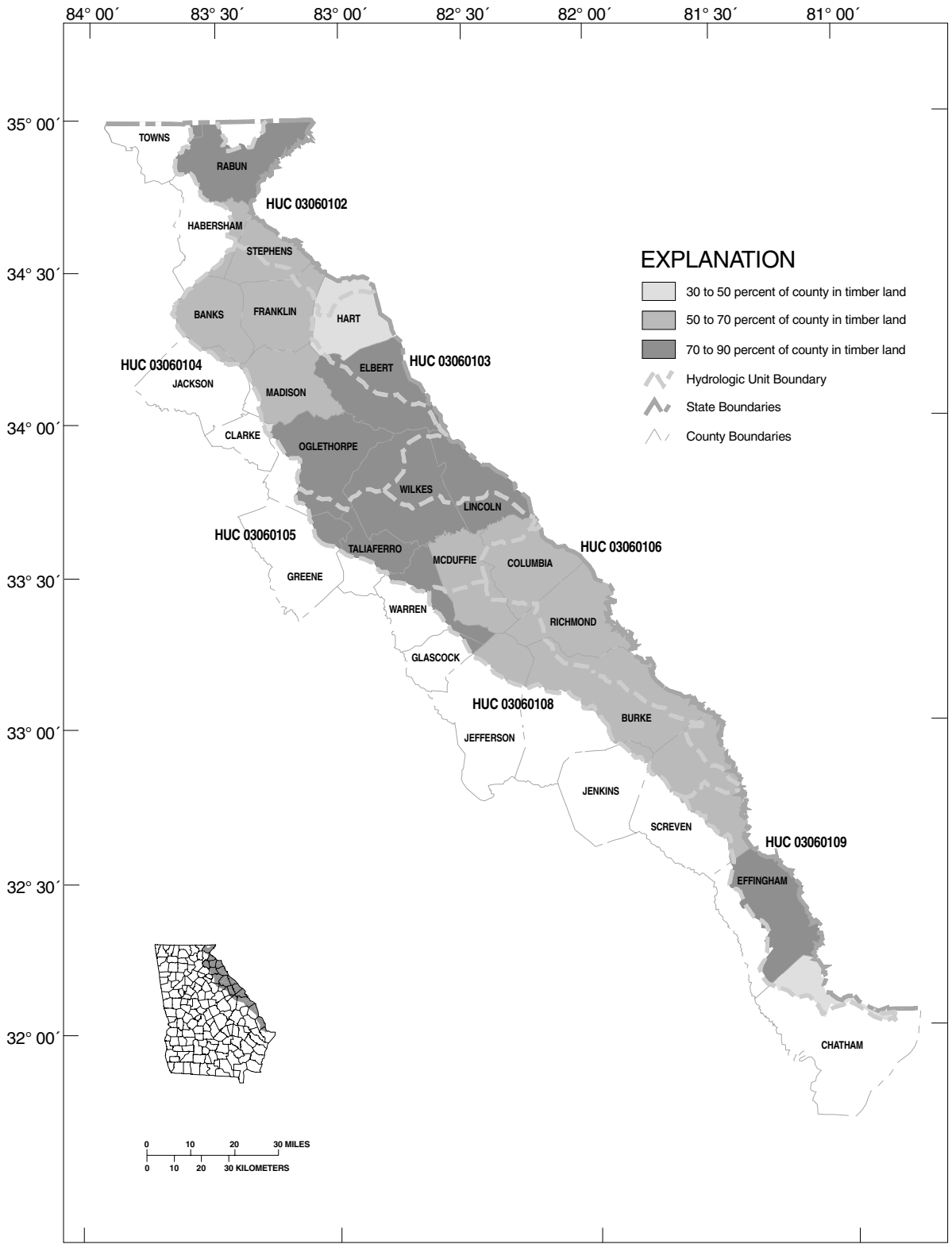

Figure 2-27. Silvicultural Land in the Savannah River Basin

Table 2-6. Forestry Acreage in the Savannah River Basin

County	Commercial Forest	Pine	Oak-pine	Upland Hardwood	Lowland Hardwood
Banks	95,100	33,900	17,200	44,000	0
Burke	210,700	64,000	28,800	67,200	50,700
Chatham	18,900	9,000	6,100	3,700	0
Clarke	800	0	0	800	0
Columbia	135,200	79,900	26,300	23,700	5,500
Effingham	161,100	89,100	8,400	29,300	34,300
Elbert	152,500	67,000	20,300	60,400	4,700
Franklin	78,200	29,100	10,600	38,500	0
Glascock	4,600	4,600	0	0	0
Greene	37,800	23,600	3,100	11,100	0
Habersham	94,800	22,600	24,700	47,400	0
Hart	54,200	8,700	3,700	41,900	0
Jackson	12,300	0	4,100	8,200	0
Jefferson	15,900	4,000	0	4,000	7,900
Jenkins	13,600	5,000	0	2,900	5,800
Lincoln	105,300	55,800	28,500	21,000	0
Madison	97,300	35,600	19,400	38,400	3,900
McDuffie	108,500	63,100	6,600	23,000	15,900
Oglethorpe	182,000	106,100	3,400	56,500	16,000
Rabun	172,000	57,700	42,700	71,700	0
Richmond	114,500	41,300	15,700	33,100	24,400
Screven	132,000	46,100	15,300	36,300	34,600
Stephens	77,400	25,800	12,500	39,200	0
Taliaferro	59,000	21,700	26,500	10,800	0
Warren	60,400	37,300	9,100	14,200	0
Wilkes	225,900	21,100	41,600	51,400	11,700
Total	*2,420,300*	*1,051,800*	*374,700*	*778,600*	*215,200*

2.3 Local Governments and Planning Authorities

Many aspects of basin management and water quality protection depend on decisions regarding zoning, land use, and land management practices. These are particularly important for the control of nonpoint pollution—pollution that arises in storm water runoff from agriculture, urban or residential development, and other land uses. The authority and responsibility for planning and control of these factors lies with local governments, making local governments and jurisdictions important partners in basin management.

The Department of Community Affairs (DCA) is the state's principal department with responsibilities for implementing the coordinated planning process established by the Georgia Planning Act. Its responsibilities include promulgation of minimum standards for preparation and implementation of plans by local governments, review of local and regional plans, certification of qualified local governments, development of a state plan, and provision of technical assistance to local governments. Activities under the planning Act are coordinated with the Environmental Protection Division (EPD), Regional Development Centers, and local governments.

2.3.1 Counties and Municipalities

Local governments in Georgia consist of counties and incorporated municipalities. As entities with constitutional responsibility for land management, local governments have a significant role in the management and protection of water quality. The role of local

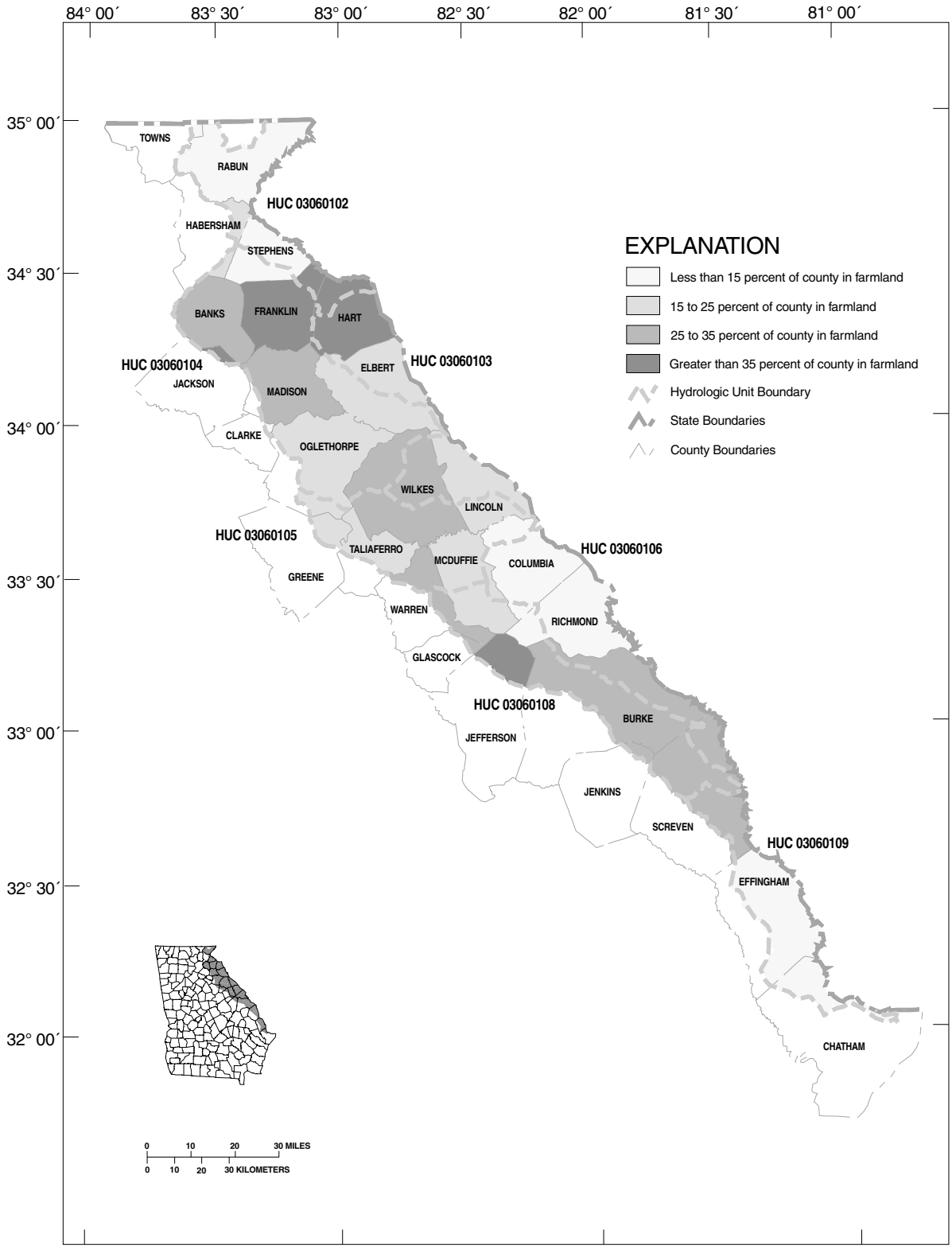

Figure 2-28. Agricultural Land in the Savannah River Basin

Table 2-7. Agricultural Operations in the Savannah River Basin (data supplied by NRCS)

Element	Watershed 3060102	Watershed 3060103	Watershed 3060104	Watershed 3060105	Watershed 3060106	Watershed 3060108	Watershed 3060109	Savannah Basin Total
Acres	374,196	454,239	938,483	493,132	366,638	500,462	380,984	3,508,134
Number of Farms (1992)	498	725	2,185	456	263	381	202	4,710
Number of Dairies (1997)	2	12	13	17	3	9	1	57
Dairy Cattle (Head 1997)	432	2,518	2,716	2,977	651	1,803	53	11,150
All Cattle and Calves (Head 1997)	17,443	38,023	87,486	26,073	10,428	16,754	5,596	201,803
Hogs and Pigs (Head 1997)	4,620	12,632	43,365	11,180	1,804	3,646	5,648	82,895
Boilers (thousands, 1997)	37,308	23,640	201,002	2,749	-	-	-	264,699
Layers (thousands, 1997)	159	193	3,887	402	-	19	-	4,660
Irrigated Acres (1995)	1,255	3,345	1,229	388	7,439	15,756	3,075	32,487
Irrigated Water Use (MGD 1995)	0.44	1.35	1.05	2.32	3.28	6.99	2.11	17.54
Harvested Cropland (Acres 1992)	10,586	24,733	43,414	1,439	31,632	60,206	21,087	193,097
Total Agriculture Acres (1989-1997)	48,233	119,475	237,965	86,607	82,703	161,603	60,597	797,183

governments includes enacting and enforcing zoning, storm water and development ordinances; undertaking water supply and wastewater treatment planning; and participating in programs to protect wellheads and significant ground water recharge areas. Many local governments are also responsible for operation of water supply and wastewater treatment facilities.

The Savannah River basin includes part or all of 27 Georgia counties (Table 2-8 and Figure 2-2); however, only 10 are entirely within the basin, and 9 counties have a small fraction (<20 percent) of their land area within the basin. Thus there are a total of 18 counties with significant jurisdictional authority in the basin. Municipalities or cities are communities officially incorporated by the General Assembly. Georgia has more than 530 municipalities. Table 2-9 lists the municipalities in the Savannah River basin.

Table 2-8. Georgia Counties in the Savannah River Basin

Counties Within the Entire Savannah River Basin	Counties Partially Within the Savannah River Basin	Counties With Less Than 20% Area Within the Basin
Banks, Columbia, Elbert, Franklin, Hart, Lincoln, McDuffie, Richmond, Stephens, Wilkes	Burke, Effingham, Madison, Oglethorpe, Rabun, Screven, Taliaferro, Warren	Chatham, Clark, Glascock, Greene, Habersham, Jackson, Jefferson, Jenkins, Towns

Table 2-9. Georgia Municipalities in the Savannah River basin

HUC 03060102				
Clayton	Satolah	Tiger	Tree	Wiley
Lakemount	Tallulah Falls	Toccoa	Turnerville	
HUC 03060103				
Chennault	Floral Hill	Montevideo	Tignal	
Danburg	Hartwell	Ruckersville	Washington	
Elberton	Lincolnton	Sybert		
HUC 03060104				
Alto	Cauthen	Fort Lamar	Lavonia	Pocataligo
Avalon	Colbert	Fortsonia	Lexington	Point Peter
Aversville	Comer	Franklin Springs	Martin	Royston
Baldwin	Danielsville	Goss	Middleton	Sandycross
HUC 03030105				
Bairdstown	Cedar Rock	Mesena	Philomath	Sharon
Barnett	Crawfordville	Metasville	Rayle	Thomson
Cadley	Leathersville	Norwood	Raytown	
HUC 03060106				
Appling	Evans	Greens Cut	Martinez	
Augusta	Girard	Grovetown	McBean	
Bath	Gracewood	Hephzibah	Pumpkin Center	
HUC 03060108				
Alexander	Camak	Hilltonia	Millhaven	Waynesboro
Avondale	Campania	Keysville	Sanit Clair	Wrens
Blythe	Dearing	Lewis	Sardis	Zebina
Boneville	Harlem	Matthews	Stellaville	
HUC 03060109				
Blanford	Meinhard	Rincon	Shawnee	Sylvania
Clyo	Monteith	Savannah	Springfield	
Garden City	Port Wentworth	Savannah	Stillwell	

2.3.2 Regional Development Centers

Regional Development Centers (RDCs) are agencies of local governments, with memberships consisting of all the cities and counties within each RDC's territorial area. There are currently 17 RDCs in Georgia. RDCs facilitate coordinated and comprehensive planning at local and regional levels, assist their member governments with conformity to minimum standards and procedures, and can have a key role in promoting and supporting management of urban runoff, including watershed management initiatives. RDCs also serve as liaisons with state and federal agencies for local governments in each region. Funding sources include members' dues and funds available through DCA. Table 2-10 summarizes the RDCs and the associated counties within the Savannah River basin.

2.4 Water Use Classifications

2.4.1 Georgia's Water Use Classification System

The Board of Natural Resources was authorized through the Rules and Regulations for Water Quality Control promulgated under the Georgia Water Quality Control Act of

Table 2-I0. Regional Development Centers in the Savannah River Basin

Regional Development Center	Member Counties with Land Area in the Savannah Basin
Central Savannah	Burke, Columbia, Glascock, Jefferson, Jenkins, Lincoln, McDuffie, Richmond, Screven, Taliaferro, Warren, Wilkes
Coastal Georgia	Chatham, Effingham
Georgia Mountains	Banks, Franklin, Habersham, Hart, Rabun, Stephens, Towns
Northeast Georgia	Clarke, Elbert, Green, Jackson, Madison, Oglethorpe

1964, as amended, to establish water use classifications and water quality standards for the surface waters of the state.

The water use classifications and standards were first established by the Georgia Water Quality Control Board in 1966. Georgia was the second state in the nation to have its water use classifications and standards for intrastate waters approved by the federal government in 1967. For each water use classification, water quality standards or criteria were developed which established a framework to be used by the Water Quality Control Board and later the Environmental Protection Division in making water use regulatory decisions.

The water use classification system was applied to interstate waters in 1972 by the EPD. Georgia was again one of the first states to receive federal approval of a statewide system of water use classifications and standards. Table 2-11 provides a summary of water use classifications and criteria for each use.

Table 2-II. Georgia Water Use Classifications and Instream Water Quality Standards for Each Use

	Bacteria (fecal coliform)		Dissolved Oxygen (other than trout streams)[2]		pH	Temperature (other than trout streams)[2]	
Use Classification[1]	30-Day Geometric Mean[3] (no/100 ml)	Maximum (no./100ml)	Daily Average (mg/l)	Minimum (mg/l)	Std. Units	Maximum Rise above Ambient (°F)	Maximum (°F)
Drinking Water requiring treatment	1,000 (Nov-April) 200 (May-October)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Recreation	200 (Freshwater) 100 Coastal)	--	5.0	4.0	6.0-8.5	5	90
Fishing Coastal Fishing[4]	1,000 (Nov-April) 200 (May-October)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Wild River	No alteration of natural water quality						
Scenic River	No alteration of natural water quality						

[1] *Improvements in water quality since the water use classifications and standards were originally adopted in 1972 provided the opportunity for Georgia to upgrade all stream classifications and eliminate separate use designations for "Agriculture", "Industrial", "Navigation", and "Urban Stream" in 1993.*

[2] *Standards for Trout Streams for dissolved oxygen are an average of 6.0 mg/l and a minimum of 5.0 mg/l. No temperature alteration is allowed in Primary Trout Streams and a temperature change of 2°F is allowed in Secondary Trout Streams.*

[3] *Geometric means should be "based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours." The geometric mean of a series of N terms is the Nth root of their product. Example: the geometric mean of 2 and 18 is the square root of 36.*

[4] *Standards are same as fishing with the exception of dissolved oxygen which is site specific.*

Congress made changes in the CWA in 1987 that required each state to adopt numeric limits for toxic substances for the protection of aquatic life and human health. To comply with these requirements, the Board of Natural Resources adopted 31 numeric standards for protection of aquatic life and 90 numeric standards for the protection of human health. Appendix B provides a summary of toxic substance standards that apply to all waters in Georgia. Water quality standards are discussed in more detail in Section 5.2.1.

In the latter 1960s through the mid-1970s there were many water quality problems in Georgia. Many stream segments were classified for the uses of navigation, industrial, or urban stream. Major improvements in wastewater treatment over the years have allowed the stream segments to be raised to the uses of fishing or coastal fishing which include more stringent water quality standards. The final two segments in Georgia were upgraded as a part of the triennial review of standards completed in 1989. All of Georgia's waters are currently classified as either fishing, recreation, drinking water, wild river, scenic river, or coastal fishing.

2.4.2 Water Use Classifications for the Savannah River Basin

Waters in the Savannah River basin are classified as either fishing, recreation, drinking water, or wild and scenic or coastal fishing. Most of the waters are classified as fishing. Those waters explicitly classified in Georgia regulations are shown in Table 2-12; all waters not explicitly classified are classified as fishing. A number of waters in the northern portion of the Savannah River basin are also designated as primary or secondary trout streams, as shown in Table 2-13. Primary trout streams are defined as streams containing naturally-reproducing populations of brook trout, brown trout, and/or rainbow trout, while secondary trout streams contain no naturally-reproducing trout populations but are capable of sustaining stocked trout throughout the year.

Table 2-I2. Savannah River Basin Waters Classified in Georgia Regulations[1]

Waterbody	Segment Description	Use Classification
Chattooga River	Georgia-North Carolina State Line to Tugaloo Reservoir	Wild and Scenic
West Fork Chattooga	Confluence of Overflow Creek and Clear Creek to confluence with Chattooga River (7.3 mi.)	Wild and Scenic
Tallulah River	Headwaters of Lake burton to confluence with Chattooga River	Recreation
Tugaloo River	Confluence of Tallulah and Chattooga Rivers to Yonah Lake Dam	Recreation
Savannah River	Highway 184 to Clarks Hill dam (Mile 238)	Recreation
Savannah River	Clarks Hill Dam (Mile 238 to Augusta, 13th Street Bridge	Drinking Water
Savannah River	US Highway 301 Bridge (Mile 129) to Seaboard Coastline RR Bridge (Mile 27.4)	Drinking Water
Savannah River	Seaboard Coastline RR Bridge (Mile 27.4) to Fort Pulaski (Mile 0)	Coastal Fishing
Savannah River	Fort Pulaski (Mile 0) to Open Sea and all littoral waters of Tybee Island	Recreation

[1] Rules and Regulations for Water Quality Control, Chapter 391-3-6(13). Waters within the Savannah River basin not explicitly classified and listed above are classified as Fishing.

Table 2-I3. Savannah River Basin Waters Designated as Trout Streams

County	Classification	Segment Description
Habersham	Primary	Middle Fork Broad River watershed from the USFS Route 92-B bridge in Stephens County
	Primary	Panther Creek watershed
	Secondary	Davidson Creek watershed
	Secondary	Middle Fork Broad River tributaries flowing into designated Secondary Trout water in Stephens County
	Secondary	Nancytown Creek watershed upstream from Nancytown Lake
	Secondary	North Fork Broad River watershed
	Secondary	Toccoa Creek watershed
Rabun	Primary	Chattooga River - all tributaries
		Tallulah River watershed upstream from the river's confluence with Lake Burton
	Primary	Bad Creek watershed (flows into Tugaloo Lake)
	Primary	Bad Branch watershed (flows into Seed Lake)
	Primary	Worse Creek watershed (flows into Tugaloo Lake)
	Primary	Bridge Creek watershed
	Primary	Crow Creek watershed (flows into Seed Lake; includes Slick Shoal Creek)
	Primary	LaCounts Creek watershed (flows into Seed Lake)
	Primary	Seals Creek watershed (flows into Seed Lake)
	Primary	Flat Creek watershed
	Primary	Fall Branch watershed
	Primary	Joe Creek watershed
	Primary	Dicks Creek watershed (flows into Lake Burton; includes Goldmine Branch)
	Primary	Moccasin Creek watershed
	Primary	Timpson Creek watershed
	Primary	Popcorn Creek watershed
	Primary	Wildcat Creek watershed
	Primary	Tiger Creek watershed
	Secondary	Chattooga River from Big Bend Falls downstream to the mouth of Warwoman Creek
Stephens	Primary	Middle Fork Broad River watershed upstream from the USFS Route 92-B bridge
	Primary	Panther Creek watershed upstream from the mouth of Davidson Creek
	Secondary	Davidson Creek watershed
	Secondary	Little Toccoa Creek watershed
	Secondary	Middle Fork Broad River watershed upstream from NRCS flood control structure #44 to USFS Route 92-B bridge
	Secondary	North Fork Broad River watershed upstream from NRCS flood control structure #1
	Secondary	Panther Creek watershed downstream from the mouth of Davidson Creek
	Secondary	Toccoa Creek upstream from Toccoa Falls

References

Burch, J.B. 1973. Freshwater Unionacean Clams (Mollusca: Pelycypoda) of North America. Identification Manual Number 11. U.S. Environmental Protection Agency, Washington, DC.

Carter, R.F., and H.R. Stiles. 1983. Average Annual Rainfall and Runoff in Georgia, 1941-1970. Hydrologic Atlas 9, U.S. Geological Survey.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe, 1979. Classification of wetlands and deepwater habitats of the United States: U.S. Fish and Wildlife Service, FWS/OBS-79/31.

GA DNR. 1996. Water Quality in Georgia, 1994-1995. Georgia Department of Natural Resources, Environmental Protection Division, Atlanta, Georgia.

Georgia Game and Fish. 1966. Savannah River Fish Population Studies, June and October 1966 (unpublished).

Heath, R.C. 1989. The Piedmont ground-water system. pp. 1-13 in Daniel, C.C. III, R.K. White, and P.A. Stone, Ground Water in the Piedmont, Proceedings of a Conference on Ground Water in the Piedmont of the Eastern United States. Clemson University, Clemson, South Carolina.

Hobbs, H.H. 1981. The Crayfishes of Georgia. Smithsonian Contributions to Zoology, Number 318.

Miller, J.A. 1990. Ground Water Atlas of the United States—Segment 6—Alabama, Florida, Georgia, and South Carolina. Hydrologic Investigations Atlas 730-G. U.S. Geological Survey. 730-G. U.S. Ge.

Neves, R.J., A.E. Bogan, J.D. Williams, S.A. Ahlstedt, and P.W. Hartfield. 1997. Status of aquatic molluscs in the southeastern United States: A downward spiral of diversity. Pages 43-85 in G.W. Benz and D.E. Collins, editors, Southeastern Aquatic Fauna in Peril: The Southeastern Perspective. Special Publication 1, Southeast Aquatic Research Institute. Lenz Design and Communication, Decatur, Georgia.

Peck, M.F., C.N. Joiner, and A.M. Cressler. 1992. Ground-Water Conditions in Georgia, 1991. Open-File Report 92-470. U.S. Geological Survey.

Schneider, W.J., E. Friel, G.C. Meyere, B.M. Wilmoth, H.E. LeGrand, C.R. Collier, G.W. Whetstone, H.C. Barksdale, and J.W. Wark. 1965. Water Resources of the Appalachian Region, Pennsylvania to Alabama. Hydrologic Investigations Atlas HA-198. U.S. Geological Survey.

Watters, G.T. 1994. An annotated bibliography of the reproduction and propagation of the Unionoidea. *Ohio Biological Survey, Miscellaneous Contributions*, 1: 1-158.

Williams, J.D., M.L. Warren, K.S. Cummings, J.L. Harris, and R.J. Neves. 1992. Conservation status of freshwater mussels of the United States and Canada. *Fisheries*, 18(9): 6-22.

Williamson, G.K., and R.A. Moulis. 1994. Distribution of Amphibians and Reptiles in Georgia. Savannah Science Museum, Inc. Savannah, Georgia.